TEMS™ CellPlanner

GeoData User's Guide

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Preface

Document Conventions

This document uses the following conventions:

Bold type	Window names, button names, and keyboard keys are displayed as bold text. Example: Click **Edit.**
Menu↗Selection	Navigation in menu paths are displayed as bold text with arrows between menu levels.
`Typewriter type`	File names and literal input and output. Example: `sites.xml`
Italic type	Book titles and definitions are displayed in italic. Examples: *carrier mapping, Technical Reference Manual*
Left-click Right-click	All instructions including mouse clicks assume a mouse configured with the left mouse button as primary button.

Navigation

Use the ALT ← and ALT → buttons to navigate between link jumps in the Manuals.

Assumed Knowledge

This documentation presumes that you have good knowledge about radio network planning principles and the radio technology to plan.

Disclaimer

The parameter values in this manual are just examples to help you getting started quickly, and do not constitute any performance guarantees for the planned equipment of your final network planning.

Proper parameter values depend on the equipment version, the operator's business plan, and the operator's network deployment strategy. Recommended parameter values should be provided by the operator, the equipment vendor or your service delivery organization.

Manuals

The following PDF manuals are delivered with the TEMS CellPlanner software:

Installation Guide
EN/LZT 108 9831 R4A

Describes system requirements, how to install and configure TEMS CellPlanner components and manage licenses, and provides an overview of all TEMS CellPlanner components. The procedures must be performed by a user with administrator privileges on the local computer. Some procedures require that you are an authorized TEMS CellPlanner administrator.

Common Features User's Guide
EN/LZT 108 9832 R4A

Includes Glossary of terms used in TEMS CellPlanner, concepts about licenses, and how use projects, explorer objects used by more than one radio technology, how to add sites and use site tools, filters, plots, neighbors, AMI, tuning propagation models, ASMT (Automatic Sector Model Tuning), puncturing, export and import data, and work with projects on server. Here TEMS CellPlanner administrators find how to administer users, groups and projects on servers shared by multiple users.

Common Features Technical Reference Manual
EN/LZT 108 9833 R4A

Describes radio technology independent algorithms, parameters and file formats.

GeoData User's Guide
EN/LZT 108 9834 R4A

Describes geodata concepts, supported geodata formats, conversion between different map formats, how to use map data tools in TEMS CellPlanner. The chapters about providing and importing map data are intended for administrators of map data. Other chapters are intended for users of map data.

Map Import Wizard User's Guide
EN/LZT 108 9943 R2A

Describes how to import map data using a generic wizard similar to the one provided with TEMS LinkPlanner. The intended reader is administrator of map data.

LTE User's Guide
EN/LZT 108 9944 R3A

Describes how to use LTE functions of TEMS CellPlanner, including analysis, and creation of plots and reports.

LTE Technical Reference Manual
EN/LZT 138 0235 R2A

Describes LTE network planning principles, analysis details for advanced users, and cell ID planning principles.

WCDMA User's Guide
EN/LZT 108 9837 R4A

How to use WCDMA functions of TEMS CellPlanner, including analysis, and creation of plots and reports.

WCDMA Technical Reference Manual
EN/LZT 108 9838 R4A

Describes concepts and overviews of WCDMA algorithms, and HSPA and MBMS in TEMS CellPlanner.

GSM User's Guide
EN/LZT 108 9835 R4A

Describes how to use the GSM functions of TEMS CellPlanner, including analysis, and creation of plots and reports.

GSM Technical Reference Manual
EN/LZT 108 9836 R4A

Describes overlaid/underlaid cell structures, reuse patterns, manual frequency planning, automatic frequency planning (AFP), automatic hopping frequency set (HFS) planning, optimization of BSIC, HSN and MAIO, fractional load planning, and effective subscriber modeling. Also describes the GSM algorithms and file formats used in TEMS CellPlanner.

WiMAX User's Guide
EN/LZT 108 9839 R4A

Describes how to use the WiMAX functions of TEMS CellPlanner, including analysis, and creation of plots and reports.

1
Overview of TEMS CellPlanner

This chapter provides an overview of the TEMS CellPlanner product.

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About TEMS CellPlanner

TEMS™ CellPlanner is a graphical PC-based application for designing, implementing, and optimizing mobile radio networks. It assists you in performing complex tasks, including network dimensioning, traffic planning, site configuration, frequency planning, and network optimization.

Installation

The Installation Guide describes how to install software and licenses.

Product Packaging

The product package includes the software components listed below.

What is actually installed depends on your selection in the installation wizard.

Product Components	Selecting this component installs...
• TEMS CellPlanner *named "TEMS CellPlanner Client" in the manuals*	• Radio Technology Features • Planning Features • Manuals • Map tools, geodata conversion software, demo maps, filters, scripts • Citrix software - relevant only if you are going to offer this TEMS CellPlanner installation as a Citrix service
• Enterprise Server	Enterprise Server software plus the User Administration software
• Zero Admin Server	Zero Admin Server software plus the User Administration software
• User Administration	User Administration software only
• License Server	License Server software only

Some of the components are licensed, see Licensed Components on page 1-3.

The Installation Guide provides an overview of each component and how the components relate to each other.

Licenses

The Installation Guide describes how to install licenses.
The Common Features User's Guide describes how to activate licensed features.

Licensed Components

Three of the Product Components are licensed:

TEMS CellPlanner *named "TEMS CellPlanner Client" in the manuals*	To start TEMS CellPlanner you need a license for at least one of the Radio Technology Features. Additional licenses are required for each of the Radio Technology Features and Planning Features to use.
Enterprise Server	License required to start the server
Zero Admin Server	License required to start the server

Radio Technology Features

Each of the radio technology software modules listed below require an installed and activated license. How to use the radio technology software is described in adherent user guides and technical reference manuals.

- GSM
- WCDMA
- WCDMA,HSPA
- WiMAX
- LTE

Planning Features

Additional planning features can be used together with the radio technology software. These additional software modules require a license for the feature itself and a license for the adherent radio technology:

• Automatic Cell Planning	Requires WCDMA or WCDMA,HSPA license
• Automatic Frequency Planning	Requires GSM license. This license is required also for automatic HFS planning.
• Automatic Measurement Integration and ASMT	Requires license for at least one of the Radio Technology Features ASMT = Automatic Sector Model Tuning.

Support and FAQ

For support and FAQ about TEMS CellPlanner, use the TEMS support web site:

www.ascom.com/networktesting

To provide TEMS support with information when reporting a problem, follow the instructions in chapter *Support Information* in the Installation Guide.

2
About Geodata

This chapter describes the basic geodata / map data concepts and the related concepts used in TEMS CellPlanner.

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Introduction

To administer and use geodata in TEMS CellPlanner you need a basic understanding of the geodata concepts.

Geodata is an important part of TEMS CellPlanner for the following reasons:

- geodata is the basis for map layers, viewed on screen by planners to locate sites
- geodata is required by the propagation models, used for pathloss calculations and other predictions

Use this chapter as a reference for understanding geodata related parameters and how geodesy might affect your radio network planning.

Note: *In TEMS CellPlanner the wording* ***map data*** *is used for map related information. In this chapter we instead use the strictly scientific terms* ***geodesy*** *and* ***geodata****, as map data in TEMS CellPlanner has a wider meaning than just "maps".*

Geodesy

All maps and geodata need a reference to the Earth. Otherwise we would not have the possibility to measure in the data or relate one feature to another. When constructing these reference systems one has to simplify the complex three-dimensional Earth into a two-dimensional mathematical construction. This science is called **geodesy**.

Ellipsoid/Spheroid and Datum

The first step in geodesy is to determine the shape of the Earth. The shape of the earth is not completely round but slightly flattened at the poles. The shape is best described as an elliptical body. This body is called an **ellipsoid** or **spheroid**, which is a rotational body described by its x-axis (or semi-major axis) and y-axis (semi-minor axis).

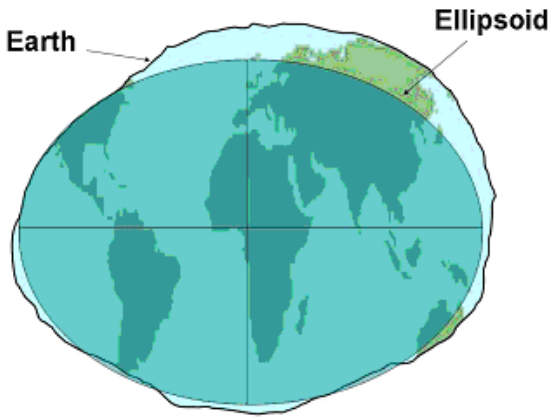

Figure 2–1 An ellipsoid is a geometrical body describing the irregular Earth.

Since an ellipsoid does not exactly match the Earth, several hundred different ellipsoids are in use throughout the world. Each ellipsoid has its different characteristics that makes it the best choice for a certain area or map. The different ellipsoids often have names from their inventor and the year they were defined, for example Bessel-1841 or Clarke-1180.

An ellipsoid, like Bessel-1841, can be placed in slightly different ways to match the actual Earth. The way an ellipsoid is placed in relation to the actual Earth is called a

geodetic datum. Each type of ellipsoid may use more than one datum. To define an ellipsoid it is thus necessary to know its datum.

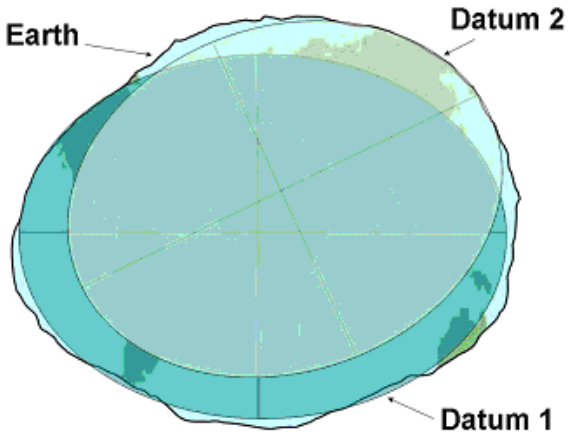

Figure 2–2 The same ellipsoid can be placed in different ways to describe the Earth. The way an ellipsoid is placed in relation to the Earth is called a datum.

A 3 dimensional ellipsoid can be used for creating a **reference system**. This is done by placing a grid over the ellipsoid so that one acquires latitude and longitude coordinates for any position on the Earths surface. These coordinates are also often referred to as **geographical coordinates**. The latitude and longitude grid is not a perpendicular reference system. The longitude degrees are for example shorter closer to the poles than at the equator.

A consequence of the fact that the geographical coordinates depend on the ellipsoid and the datum is that the same spot on the Earth surface will have different latitude and longitude coordinates with different ellipsoids and datums. The difference can be up to 800 meters depending on datum. *It is therefore important to keep in mind which reference system has been used for various input data*.

Geodata can be transformed from one datum to another by various methods. The simplest way is by a so called 3-parameter transformation. This transformation is performed in three dimensions - X, Y and Z (height) - between the two datums. The transformation is described by a **shift** in each dimension. The shifts are named dX, dY and dZ.

Projection

To represent the three-dimensional Earths surface into a two-dimensional representation on a computer screen or a paper map, it is necessary to use a mathematical model called a **projection**. To understand this, one can imagine a large paper wrapped around the Earth. A light source is then placed in the middle of the

Earth and the positions are projected onto the paper. In this way a **cylindrical projection** is created. Often the projection process is far more complex.

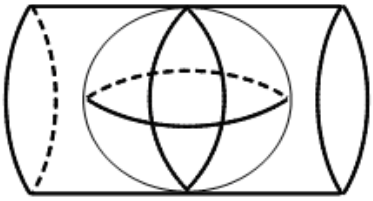

Figure 2–3 Example of a cylindrical projection

There are thousands of different projections in use, each with innumerable variations. Most projections usually fall within one of the larger groups, such as **cylindrical**, **conical** or **planar projection**. Common for all projections is that they create a **distortion** of the data**,** either in scale, distance or area. This is an effect of reducing the data from 3 dimensions to 2 dimensions. Therefore all projections contain errors and each projection has its pros and cons. When constructing and selecting a projection it is a matter of controlling the errors.

For projected geodata it is possible to set up a perpendicular Cartesian coordinate system instead of using latitude and longitude coordinates. Each point can then be referred to with an X and Y coordinate in for example meters, counted from a chosen place of origin (origo of the coordinate system). The place of origin is normally defined by its **latitude of origin** and **longitude of origin**.

The Geoid – a Height Reference

The surface of the Earth is not smooth but irregular, full of ups (mountains) and downs (oceans). To determine the elevation for a point we need a reference. The sea level is often used as a reference surface. Since the sea level is constantly changing the surface of the Earth is very complex and challenging to use as reference.

Instead scientists have defined a surface called the **geoid**. It can simply be described as an imagined predefined sea level that covers the entire Earth, even under the continents. It is defined as an equipotential surface in the gravity field of the Earth. This means a surface where the magnitude of the gravity is **constant**. So in reality it is more correct to speak of the height above the geoid rather than the height above the sea.

UTM and WGS-84

A world standard when it comes to projections is **Universal Transverse Mercator projection**, called **UTM**. This is a type of cylindrical projection that has been found to have good representation for larger areas and it displays angles correctly. The global UTM coverage is divided into 60 zones, each with a width of 6 degrees. The

zones are further divided into the **northern and southern hemispheres**. Each of these 120 zones has its own origin for measuring the positions in **meters**.

Perhaps the most commonly used ellipsoid today is **World Geodetic System 1984,** called **WGS-84**. WGS-84 is also defined as a datum. It is a world reference system created for the GPS system. The WGS-84 ellipsoid has a semi-major axis of 6 378 137.00 meter and a semi-minor axis of 6 356 753.31 meters.

The positions measured by a GPS is always in WGS-84 latitude and longitude and the height is above the WGS-84 ellipsoid. In most GPS receivers it is possible to get positions in other reference systems. However the positions are always measured in WGS-84 and then transformed to another reference system. The accuracy of the transformation depends on the quality of the receiver and might not always be accurate.

Reference Systems in TEMS CellPlanner, Examples

In TEMS CellPlanner it is possible to use a number of different ellipsoids, datums and projections.

The tool also has a number of predefined reference systems that are used in various countries. They are called **coordinate systems**. Each coordinate system includes a predefined datum and projection.

An example is the coordinate system British National Grid which is based on the datum OSGB 1936 England (which is adaptation of the Airy 1830 ellipsoid) and a Transverse Mercator projection with some parameters specific for England.

It is possible to view all the parameters for each type of reference system in TEMS CellPlanner, as in the following examples:

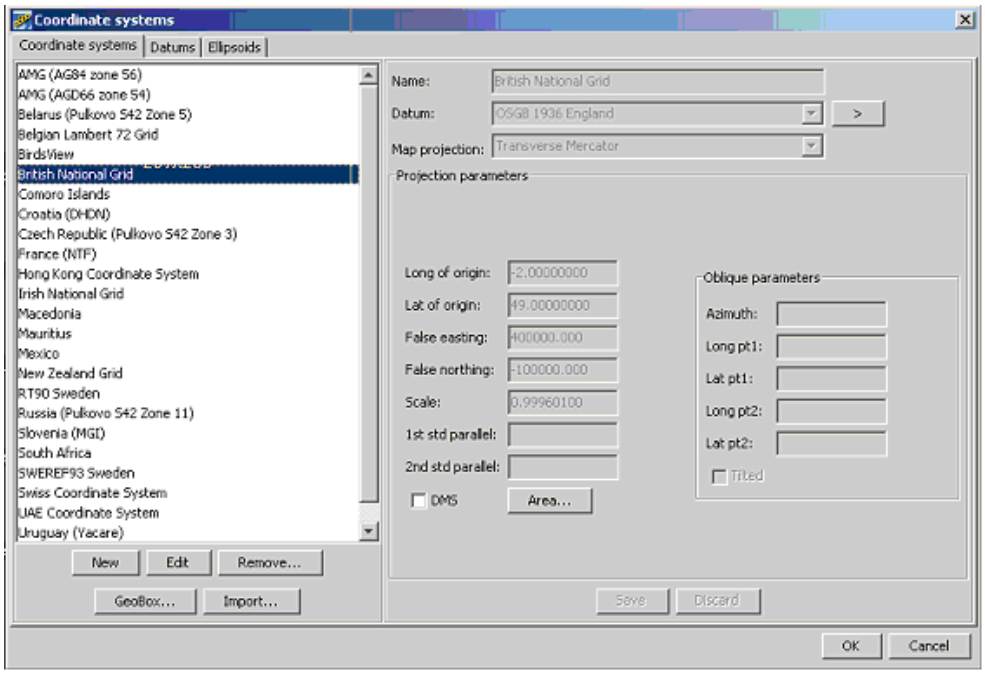

Figure 2–4 Example parameters of the coordinate system British National Grid

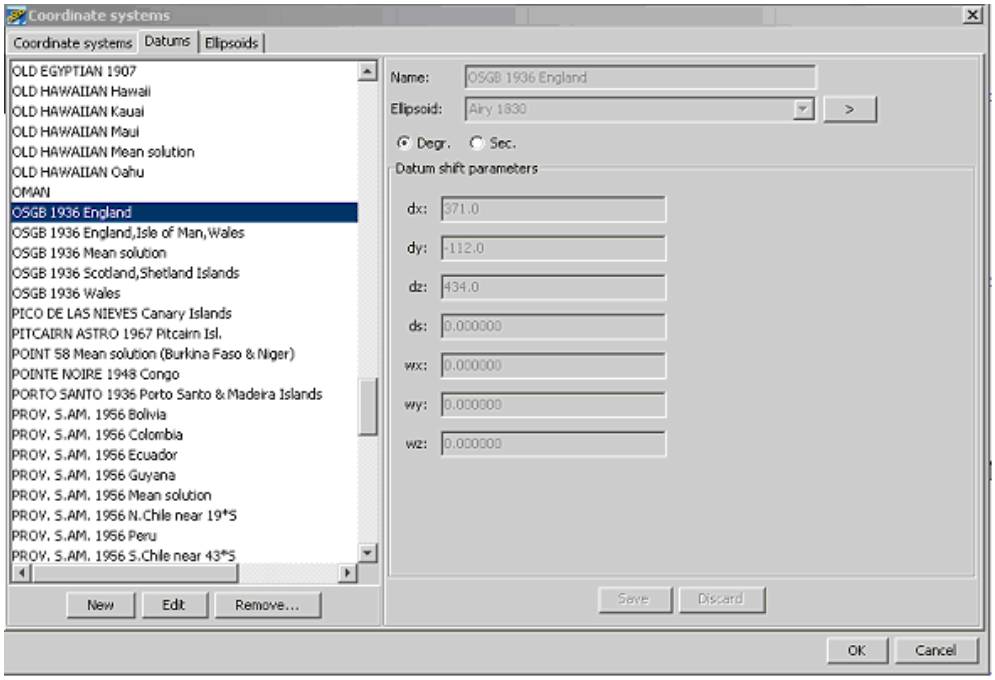

Figure 2–5 Example parameters of the datum OSGB 1936 England

Geodata

This chapter introduces some concepts of **geodata**, that is, digital geographical data, that must be handled correctly to obtain correct planning results. It also describes the different sources of digital geodata and how digital data can be stored, as well as important aspects of accuracy and resolution.

Source Data

When producing geodata for network design, the best source material is normally a combination of topographical maps and satellite images. The quality of the dataset is totally dependent on the quality of the source material. "What goes in – comes out" is very much true in this case.

Topographical Maps

Most geographical datasets use information from **topographical maps** as a basis. These maps include height information in the form of contours, land usages (features like forests, urban areas and so on), linear features (like roads, railways, rivers) as well as text. They usually have a well-defined coordinate system. These maps normally vary in scale from 1:200 000 to 1:10 000. A governmental body in each country, or in certain countries the military, often produces topographical maps. Availability might be a problem as they in some cases are considered to be military secrets.

Topographical maps are normally used for extracting elevation or terrain data, as a support and reference for interpreting the clutter and vector information. Because of their well-defined reference system, topographical maps are also used for georeferencing the data, see chapter Geodesy on page 2-4.

The choice of scale is often a combination of the level of accuracy needed and the availability of maps.

Production of topographical maps is a large undertaking and they are therefore seldom updated. Therefore **satellite images** are often used to obtain the most recent information. Topographical maps are at least 5-10 years old. For the elevation data this might not be a big problem since the terrain changes very slowly (if at all). In wireless network design it is however of great importance that the landuse and vector data is updated with the most recent information. In most cases satellite images are used for updating landuse and vector information. There are a large number of satellites in orbit around the globe. They are used for various purposes, like meteorology, military or earth observation. The earth observation satellites are the ones normally used for updating geodata for network design.

Satellites use digital sensors to register electromagnetic waves from the visible part of the spectrum as well as invisible, like infrared or radar. The resulting images are therefore not comparable to traditional photos. For satellite images the crucial parameter is the resolution, which determines the smallest detectable object in the image. The satellite sensors range from low-resolution sensor (around 200 meter)

found in weather satellites, over medium-resolution sensors (30 meter – 10 meter) such as LANDSAT, SPOT, IRS to high-resolution sensors that capture images with a resolution of 5 meter to 1 meter. Such satellites are Quickbird, IKONSOS and Orbview

SRTM Elevation Data

A new source for elevation data is the **Shuttle Radar Topography Mission (SRTM) elevation data**. It is an elevation database produced from radar measurements by NASA. It has a resolution of 3 arc-seconds (approximately 90 meters) except for US territory which has a resolution of 1-arc-second (approximately 30 meters). The coverage is near-global, extending from 60 degrees South to 60 degrees North. The SRTM elevation data are in some parts incomplete and in other parts the elevation values might not be altogether correct. The data are available for free from NASA.

The SRTM elevation data has in many circumstances replaced traditional topographical maps as a source for terrain data when designing medium to low resolution data. It is both cheaper and more accessible than topographical maps.

Map Data Representation, Raster or Vector

Digital geographical data can be represented in two map data representations, either as vector or raster data.

Vector Data

In vector data the geographical features are captured and stored as single points. A **line** is defined by several points and how they are related. An **area** is represented by the first and the last point in a line being the same, to form a closed object. The points are defined by their x and y coordinates, and for height data, their z values.

It is also possible to attach additional information to each vector, this information is called **attributes**. The attributes could be for example road classes or cable widths.

In TEMS CellPlanner all **linear data** (such as roads, railways, shorelines and so on) and **text** are stored as vector data.

Raster Data

Raster data is information stored as pixels (bins or small squares) each one with its own value, representing whatever is mapped (height value, landuse code, color codes). Raster data representation is like placing a matrix over the ground and record the feature that falls within each pixel. The size of these pixels in the matrix is called the **resolution**. The resolution is measured as the "actual" size of the pixel on the ground.

In TEMS CellPlanner the height data, landuse data and backdrops (images) are stored as raster data.

Vector Data versus Raster Data

Both formats have their pros and cons, as outlined in the following table:

Vector Data	Raster Data
Suitable for low data volumes	Suitable for large data volumes
Faster to display	Slower to display
Not o easy to convert	Easier to convert

When data is converted from vector to raster or from raster to vector it will be changed and distorted.

When vector data is **rasterized**, that is, converted from **vector to raster**, all line elements will be interpreted as pixels, the size of the pixels determined by the chosen resolution. In the example in Figure 2–6 you can see how an imagined grid is placed on top of the vector data and each pixel is classified as building or not-building. The result will be a slightly changed representation of the building. In some areas it has "grown", in other areas some parts are missing.

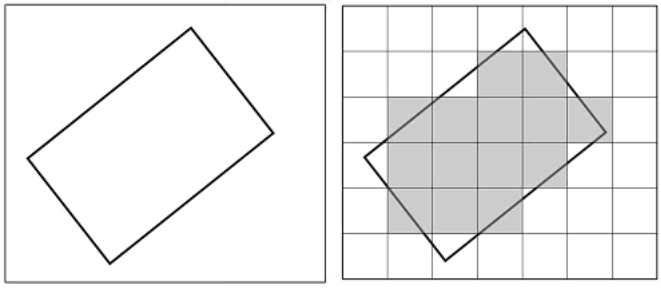

Figure 2–6 When a building in vector format is converted to raster format, the shape might be affected.

Data that is **vectorized**, that is, converted from **raster to vector**, will normally keep the area distribution correctly, but the resulting vector data will look rather "pixly" and not very natural.

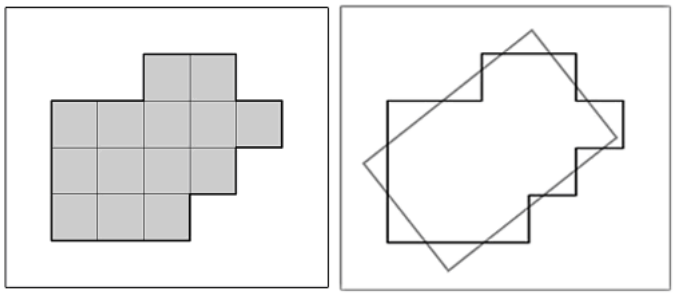

Figure 2–7 When the building is converted from raster back to vector, the effects of going between the two data types are obvious.

Accuracy and Resolution

It is important to distinguish between accuracy and resolution for geodata.

Accuracy

The **accuracy** is a measure on how well the position of different features in the data represent their true position on the ground. One can distinguish between absolute accuracy and relative accuracy.

An **absolute accuracy** of +/- 10 meter means that the positions in the geodata can be expected to be not more than 10 meters from their true location in reality. The level of absolute accuracy depends on how well the source data has been georeferenced.

A **relative accuracy** of +/- 10 meter means that the positions within the geodata does not differ more than 10 meters. It is a measurement of the internal geometry. The relative accuracy depends on how good the different sources are, for example satellite images.

As a consequence, a geodata layer can have a very good relative accuracy (internal geometry) but a poor absolute accuracy, being inaccurately placed on the Earth.

The concept of accuracy applies to both vector and raster data.

Resolution

The **resolution** is simply the size of the pixels or bins that constitutes a raster image. This size can be arbitrarily chosen and does not necessary reflect the accuracy of the data. Resolution applies only for raster data.

As mentioned above the resolution does not necessarily have anything to do with the accuracy of the data. The following can be used as an example; a geodata set is produced from medium-resolution satellite images with a relative accuracy of 20 meters. The features are captured as vector lines. The vectors are then rasterized with a pixel size of 20 meters to reflect the source data. This data will then have a resolution of 20 meters.

Now, if this data is re-sampled to 10 meters resolution, the resulting geodata will not contain any additional information compared to the 20 meters data. The only

result will be 4 times more pixels (data) to work with. A higher resolution does not guarantee a higher accuracy.

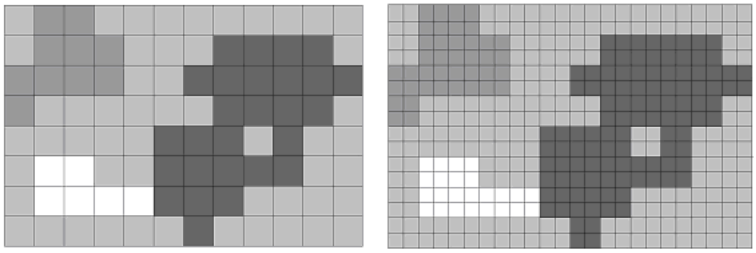

Figure 2–8 A re-sample of data from 20 meters to 10 meters resolution does not result in more information or better accuracy.

Cell Planning with Geodata

Geographical information is a critical factor for wireless network planning. The planning and propagation predictions in TEMS CellPlanner should be based on the best available geographical data. The data needs to be updated and should reflect the true on-ground situation. The level of detail and the accuracy has to be on the right level for the projects using the geodata.

There are many geodata products and vendors on the market. It is often difficult to choose the right type of data for the project at hand. How does a planner "see" the quality of the data? Outdated or imprecise geodata can result in erroneous predictions or a misleading planning.

Recommended Resolutions

This section describes the recommended resolutions for different scenarios.

Regional Data

A regional dataset with a resolution of about 60m is suitable for wireless planning in rural areas and wider areas, for example to cover parts of a country or a whole country. The data is based on topographical maps at 1:100 000 – 1:200 000 scale and entirely or partially updated with satellite images. The advantage of using 60m resolution is to reduce the amount of data but still cover a large area and to get an acceptable level of detail. At this level it is possible to differentiate between a few urban classes and some vegetation classes as well as water and open areas.

City Data

The city dataset with 10-20m resolution is suitable when designing radio networks and transport networks for an urban area. The data is based on satellite images from medium-resolution satellites and topographical maps (e.g. 1:25 000- 1:100 000). In 20m resolution, different urban areas are well represented. It is possible to classify urban areas of different density and structure.

High-resolution Data with Building Heights

For a very detailed planning in an urban environment the use of high-resolution geodata (1-5m) with building height data greatly improves the result. The building data is normally captured from high-resolution satellite images and represented as box shaped houses. The building data, just like the terrain data, is stored as raster data.

A mix of the above mentioned data types would give a strong geographical foundation for a successful wireless network design. With 60 meter data for a whole country, 10-20 meter data over the major cities and high-resolution building data for the central parts of 1-2 important cities one is well-equipped to meet any planning challenges.

Known Difficulties

The geodetic parameters can cause some confusion for the TEMS CellPlanner user if not handled correctly. It is important to know which reference systems are used for the geodata when importing it into TEMS CellPlanner. If not it can result in a mismatch of positions. An example is when geodata and imported site positions have coordinates in different reference systems.

Another common problem is different height references. Most topographical maps and digital geodata use the geoid as reference for the heights. However many satellite positioning systems use an ellipsoid as reference instead. In the case of the GPS system, it is WGS-84 ellipsoid. This means that the same spot can have two different height values.

TEMS CellPlanner Geodata Concepts and Glossary

TEMS CellPlanner introduces a number of geodata related terms and concepts that you need to understand to use geodata in a proper way in the tool. This chapter defines and describes the most important of those terms, as well as some basic geodata terms.

bin

A raster data element carrying one value (pixel) of multiple values. A multi-value bin includes an array of values, for example plot value, demographic value, and so forth. You can define your own bin size, but usually the bin size is defined in relation to the map data resolution, for example, 5 x 5 meters or 20 x 20 meters.

A bin is the smallest unit for which cell planning can be done. See *Glossary* in the *TEMS CellPlanner Common Features User's Guide* for a definition from the cell planning perspective.

conversion

Change of map format with or without changing the map data representation.

The following conversions can be done during importing or preprocessing:

- raster to raster
- vector to vector
- vector to raster

The following conversions can be done when Exporting Map Data:

- raster to vector
- raster to image
- raster to raster
- vector to vector

coordinate system

See reference system.

DMS

Degree-Minute-Second. Representation of a coordinate reference system, of syntax DD°MM'SS.ss".

Alternative representations:

- East/North (meter)
- Decimal (DD.ddddd)

demographic data

See demographics map type.

EriMap

The GIS in TEMS CellPlanner is named *EriMap*.

feature

In the geodata context, a feature is digital information about an object with a geographical location, such as building, river, forest, road, railway and similar.

(In a TEMS CellPlanner installation context, a feature is a well-defined functionality selected or not selected to be installed).

GeoBox

A "map format" with different map types separated in map layers, where each map layer has its own map data representation.

Geographic Information System (GIS)

Software handling geodata. The TEMS CellPlanner GIS is named EriMap.

geodata

Digital geographical data

geographic

A geographic coordinate reference system does not have any Projection and is named "LoLa", where Lo = longitude and La = latitude.
Example: SRTM elevation data with coordinate system WGS-84 (LoLa).

map data

The TEMS CellPlanner term for geodata, described by its:

- map data representation
- map type

map data representation

How map data is represented in data structures. TEMS CellPlanner supports the following representations:

- raster data
- vector data
- text data

map format

The type of map data distinguished by its file extension(s). The map formats recognized by TEMS CellPlanner are listed in Supported Map Data Formats.

map layer

A layer of a certain map type, selectable for display and/or predictions as described in Working with Maps and Map Layers.

map type

The **content** of the map data, represented as a map layer. The map types supported by TEMS CellPlanner vary slightly between different map formats.

The table below shows the supported map types and the icons used for source and target files including these map types:

Map type	Description
landuse / clutter	**LandUse** (GeoBox name) data is stored as two-dimensional matrices of grid cells. Each cell contains a value representing a landuse code for the area covered by the landuse category. **Clutter** (Planet DMS name) data is stored in a binary raster format as a meter grid even. The coordinates can be viewed in latitude/ longitude.

Map type	Description
elevation / heights	**Elevation** (GeoBox name) data is stored as two-dimensional matrices of grid cells. Each cell contains a value corresponding to an elevation above mean sea-level for the area covered by the cell. **Heights** (Planet DMS name) data is stored in a binary raster format as a meter grid. The coordinates can be viewed in latitude/ longitude.
vector	GeoBox vector data is points, lines and areas where each point or node is stored as a pair of coordinates, easting and northing. Planet DMS vector (line) data describes roads, railways, coastlines and similar. Stored either in ASCII text files or in a proprietary binary format.
text	Text data consists of ASCII data such as town names, city names, and so forth. Stored as a line of text followed by the easting and northing of the text.
images / backdrop	**Images** (GeoBox name) or **backdrop** (Planet DMS name) data can be satellite images, aerial photos or scanned maps, stored as two-dimensional matrices, either in a GeoBox formatted database or in standard image format such as TIFF.
buildings / building	**Buildings** (GeoBox name) or **building** (Planet DMS name) data is used for microcell planning. Stored as two-dimensional matrices of grid cells.
traffic	Traffic (GeoBox name) describes demographic and statistical distribution of live traffic. Stored as raster.
demographics	Demographics (demographic data) describes the population density of a certain demographic category, such as income, age, education level, or mobility. Measured in individuals per square kilometer. Stored as multi-resolution raster.

MRR

Multiple Resolution Raster, see multiple resolution.

MRV

Vector format for multiple levels of detail for efficient zoom in and out. Mandatory format for vector and text data in computers with 64 bits JVM.

multi-attribute vector

Vector source data including multiple attributes, where each attribute describes the characteristics of an object.

multi-resolution

See multiple resolution.

multi-valued raster

Internal representation of raster data with multiple values per bin, for example demographic data values and plot values.

multiple dataset

Multiple dataset map data is a combination of more than one source database.

multiple resolution

Also called multi-resolution.

Multiple resolution raster data is an MRR database converted from raster source databases of different resolutions. Example: A source database of resolution 20m can be combined with a source database of resolution 5m, resulting in a multi-resolution target database of 20m+5m.

If the MRR database origins from a single source database, the resolution in the target MRR database is the same as in the source database.

pixel

A single-valued bin.

raster data

A map data representation modeling geographic objects as arrays of pixel values.

reference system

A combination of a 3D ellipsoid, a datum and a projection representing the earth. A predefined reference system in TEMS CellPlanner is called a coordinate system.

reprojection

See transformation.

single-valued raster

Internal representation of raster data with only one value per bin, for example landuse, elevation, or image.

source database

A single map data file including all data and metadata, such as coordinate system and resolution. A source database includes information about one map type only. When browsing folders from the import and preprocessing procedures, TEMS CellPlanner detects a source database by reading its contents, and presents it as a map type dependent icon in the browser.

Map data possible to open as source database can be used for predictions. Exception: The current version of TEMS CellPlanner does not support demographics source database as input to predictions.

The preprocessing procedure can convert multiple source databases of the same map type to MRR, at the same time, or by adding a source database to an existing MRR target database.

The map formats possible to open as source database are listed in Supported Map Data Formats.

source files

A set of files of the same map type, or a single file. When browsing folders from the import and preprocessing procedures, TEMS CellPlanner detects source files by their extension.

The map formats possible to open as source files are listed in Supported Map Data Formats.

text data

A map data representation applicable in computers with 32 bits JVM.
For 32 bits JVM, text data may be converted to vector data of MRV format.
For 64 bits JVM, text data must be converted to vector data of MRV format.

transformation

Change of coordinate reference system. Also called reprojection.

vector data

A map data representation modeling geographic objects by geometric shape and lists of data attributes. Also called object data.

3
Providing Map Data to TEMS CellPlanner Users

This chapter describes how to provide map data (geodata) for viewing and use in predictions in TEMS CellPlanner.

The intended reader is an administrator of map data.

Topics **Page**

Map Data Administrator's Process 3-2
Required and Recommended Map Formats 3-3
Do TEMS CellPlanner Clients use 32 Bits or 64 Bits JVM? 3-4

Map Data Administrator's Process

As an administrator of map data you must ensure that the map data to use in TEMS CellPlanner is available in the expected format.

A large number of map formats can be used as source data, some of them requiring conversion to other formats. For a complete survey, see Supported Map Data Formats on page 8-2.

To provide map data to TEMS CellPlanner users, follow the process below:

1. Read Cell Planning with Geodata on page 2-14.
2. Acquire the map data from your map data provider, considering Recommended Resolutions on page 2-14.
3. Store the map data files on the computer(s) dedicated for map data. If the map data is of format Planet DMS, ensure you follow the naming rules, see Planet DMS (EET/Planet) and Asset Folder Naming Rules on page 8-7.
4. For each source database and for all source files, plan the target map formats, map data representations and coordinate reference systems.
5. Plan for conversion and/or transformation of the map data.
6. Choose the suitable method(s):
   - Convert Raster Data to MRR
   - Convert Vector or Text Data to MRV
   - Convert Demographic Data to MRR
   - Advanced Import of Map Data
   - Transform Map Data (reproject only, no format change)

   You can perform transformation during converson.

Required and Recommended Map Formats

The required and recommended map formats depend on the expected use of the map data. As an administrator of map data you must find out the following:

- Do TEMS CellPlanner Clients use 32 Bits or 64 Bits JVM?
- Will the map data be used for predictions, or for viewing only?

When you know the needs for all TEMS CellPlanner clients that will use the map data, plan for conversion to the desired format according to the following table:

JVM	Map data representation		
	Raster	Vector	Text
32 bits	**MRR** format **required** for map types: • landuse • heights • demographic data For all other map types, **MRR** format is **recommended** for good performance in zoom-out speed, level of details in viewing, and calculations.	Any vector format allowed	Any text format allowed
64 bits	**MRR** format **required**	**MRV** format **required**	

Note: *Demographic data (MRR) can be displayed as a map layer but is not considered in predictions in the current TEMS CellPlanner version.*

Do TEMS CellPlanner Clients use 32 Bits or 64 Bits JVM?

The computer hosting the TEMS CellPlanner Client (that will use the map data) has an operating system compiled for 32 or 64 bits addressing range.

When installing the TEMS CellPlanner Client, the installation program checks the addressing range of the operating system and selects to install the appropriate Java Machine (JVM), for 32 bits or 64 bits.

With a 64 bits JVM installed, you must convert all vector and text data to MRV, otherwise the TEMS CellPlanner Client can not read it.

If you do not know if 32 or 64 bits addressing range is used by the operating system where the TEMS CellPlanner Client is installed, do as follows:

1. Open a browser explorer.
2. Locate the TEMS CellPlanner installation folder.

   The default name of the installation folder is C:\Program Files\Ascom\TEMS Products\TEMS CellPlanner 8.x.y, but the real location is selected during installation.
3. If the folder `jre64` is present in the installation folder, 64 bits JVM is used. Otherwise, 32 bits JVM is used.

Note: *The folder jre32 is always present.*

4
Importing and Converting Map Data

Describes how to import or preprocess map data and convert it to a new format and/or data representation, and how to transform (reproject) map data. Examples of import with conversions are described in the procedures.

The intended reader is an administrator of map data.

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Preprocessing Demographic Data 4-5
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View Map Data

Before import you should examine your source data to verify that it has the expected characteristics.

After import you can also examine your target data for the same reason.

Prerequisites

You have access to map data.

Procedure

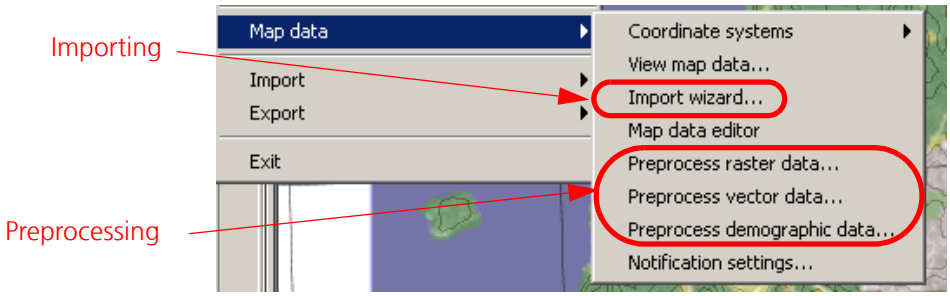
Do as follows to examine the map data:

1. Select **File↗Map data↗View map data...** to display the **Map data details window**.
2. Select **Open database** to examine a source database, or **Open map file** to examine source files.
3. In the **Map data details** window, select the map data to examine, and click **Open**. The window is updated with map data organized in tabs. Exactly which tabs appear depend on the type and contents of the map data.
4. In tab **Definitions** you find data type, map type, and coordinate system.
5. In tab **Coordinates** you can check the N/W/E/S coordinates and topo size in meters, as well as the accuracy in east, north and Z, if defined. For raster data you can check the resolution(s).
6. In tab **Map view** you can graphically display the map data.
7. In tab **File structure**, you can check attributes in vector map data.
8. In tab **Bin statistics** you can analyze statistics of raster data.
9. In tab **Vector statistics** you can analyze statistics of vector data.

Tools for Import of Map Data

Once you know the Required and Recommended Map Formats you can use the map converting tools of the TEMS CellPlanner Client to convert your map data.

Preprocessing and **importing** map data are similar methods for conversion and/or transformation of map data, but they are used for different purposes and have different limitations, as described below. The methods are implemented as separate tools started from the **File↗Map data** menu:



Comparison Between Preprocessing and Advanced Import

Preprocessing is the recommended method for target format MRR or MRV, as it is easier to use than advanced import.

Advanced Import is the most flexible method as it can perform all combinations of conversions, except for the case where demographic data is included in the map data.

None of these methods modifies the source data, unless target data is set to the same as source data.

Both methods allow different resolutions and coordinate systems in multiple source data when merging to one target.

Study the requirements and limitations in the following overviews to find which method that best suits your needs:

- Preprocessing Raster Data
- Preprocessing Vector Data
- Preprocessing Demographic Data
- Advanced Importing

Preprocessing Raster Data

The tool **Preprocess raster data** ...

- converts raster data to MRR

- is used mainly for migration to 64 bits JVM
- must be used for
  - conversion of raster source data from multiple datasets*
  - conversion of raster source data of different resolutions*
  - addition of raster source data to existing MRR database*
- requires source database as input
- source and target must be of the same map type:
  - clutter to clutter (landuse to landuse)
  - elevation to elevation
  - image to image
  - buildings to buildings
  - traffic to traffic
- *) cannot import demographics in the current TEMS CellPlanner version, use instead Convert Demographic Data to MRR.

The use of this tool is described in Convert Raster Data to MRR.

Preprocessing Vector Data

The tool **Preprocess vector data** ...

- converts vector or text data to MRV
- is used only for migration to 64 bits JVM
- must be used for
  - conversion of vector or text source data from multiple datasets*
  - conversion of vector source data of different resolutions*
  - addition of vector or text source data to existing MRV database*
- requires source database as input
- source and target must be of the same map type:
  - vector to vector
  - text to text
- *) cannot import demographics in the current TEMS CellPlanner version, use instead Convert Demographic Data to MRR.

The use of this tool is described in Convert Vector or Text Data to MRV.

Preprocessing Demographic Data

The tool **Preprocess demographic data** ...

- must be used to import demographic data
- requires single-valued raster source database or multi-attribute vector source files as source data
- translates raster data into demographics and stores as MRR
- reads vector data including demographic data and converts to MRR
- stores target as MRR including one or more demographics categories
- can only merge map data of the same map type and map data representation into the same target

The use of this tool is described in Convert Demographic Data to MRR.

Advanced Importing

The tool **Import wizard**...

- must be used for conversion and/or transformation of:
  - source files to source database as an intermediate step before preprocessing
  - one map data representation to another, like vector to raster
  - any other target map format than MRR or MRV
- cannot import demographics in the current TEMS CellPlanner version, use instead Convert Demographic Data to MRR.

The use of this tool is described in Advanced Import of Map Data.

Convert Raster Data to MRR

The preferred method for conversion of raster map data to MRR is **preprocessing** with the **Preprocess raster data** tool.

Example: Preprocess Planet DMS Raster Data, Convert to MRR.

Exception: To convert raster data into demographics, see instead Convert Demographic Data to MRR.

See also:

- Required and Recommended Map Formats on page 3-3 about reasons to convert to MRR.
- Supported Map Data Formats on page 8-2 for a complete survey of source and target map formats.
- Advanced Importing on page 4-5, an alternative method allowing conversion of one source database by **importing** to GeoBox and select MRR as target format.

Preprocess Planet DMS Raster Data, Convert to MRR

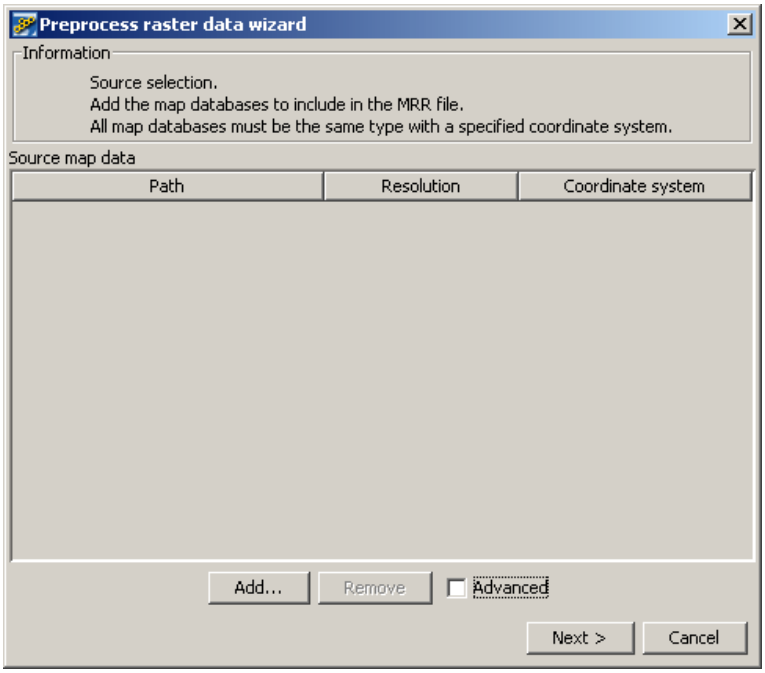
This example shows conversion of Planet DMS clutters to MRR.

Prerequisites

- The source data to convert to MRR must be possible to open as source database, otherwise you must first perform Advanced Import of Map Data.
- If your source database(s) is of format Planet DMS, do as follows:
  - Create the appropriate coordinate reference system, see Add Coordinate System on page 5-6
  - Ensure that the folders of the source database(s) are correctly named, see Planet DMS (EET/Planet) and Asset Folder Naming Rules on page 8-7

Procedure

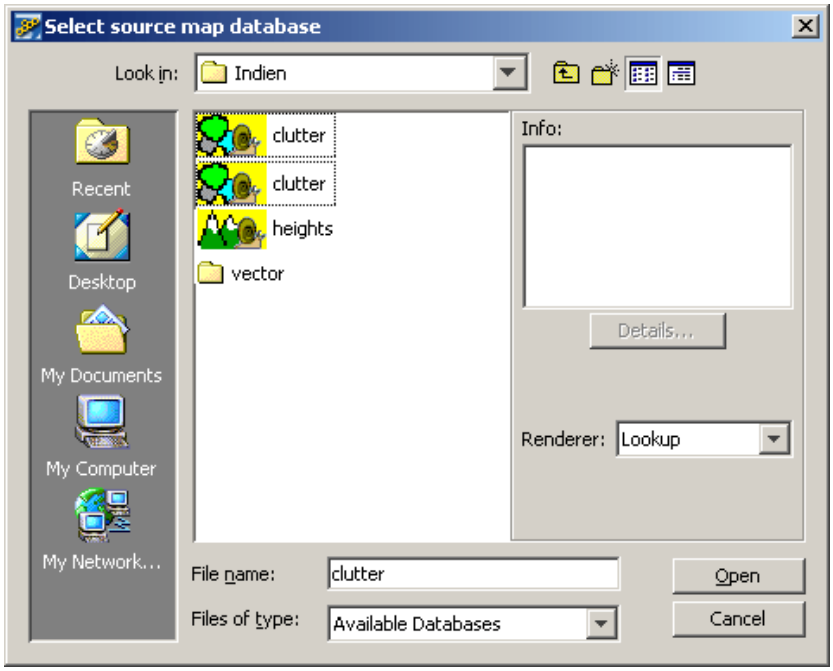
1. Select **File↗Map data↗Preprocess raster data** to display the **Preprocess raster data wizard**, as shown in the following example:



2. Ensure the **Advanced** option is cleared.

Note: *Select the Advanced option only if you want to manually select display order of two or more source databases of different resolutions. This is normally not needed, as the map data of the finest resolution by default will be displayed on top of the map data of coarser resolution. As an example, if you select two clutter source databases of resolution 5m and 20m respectively, the one with 5m resolution will be displayed on top of the one with 20m resolution.*

3. Click **Add** to open the **Select source map database** browser and locate source database folder(s). You see that the map data is recognized as source database if the folder name is preceded by a raster map type icon:

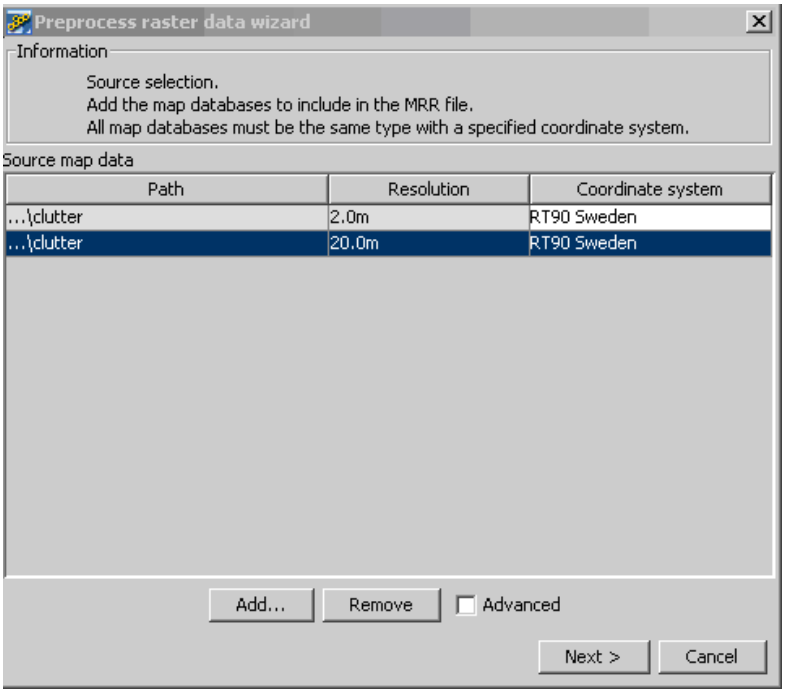


4. Select the source database(s) to convert to MRR and click **Open**.

Note: *You must select database(s) of raster* map type *only. If you select more than one source database, they must all be of the same* map type*, otherwise you can not proceed with the preprocessing.*

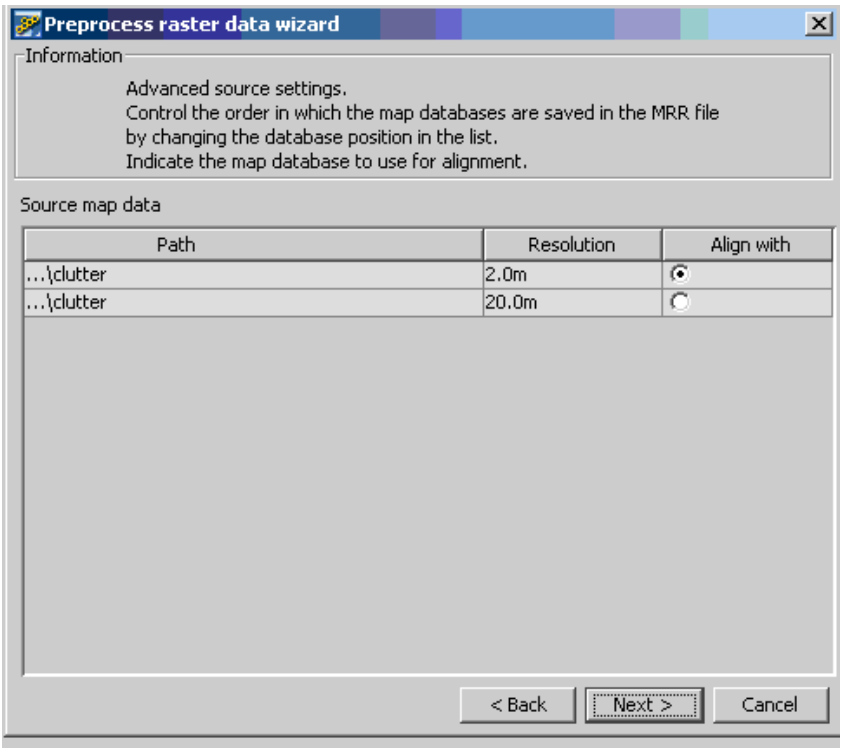
5. The **Select source map database** is closed **and** the **Preprocess raster data wizard** window displays the added source databases, their respective resolution and -

not for Planet DMS - coordinate system. The source database with the finest resolution appears at the top of the list, as in the following example:



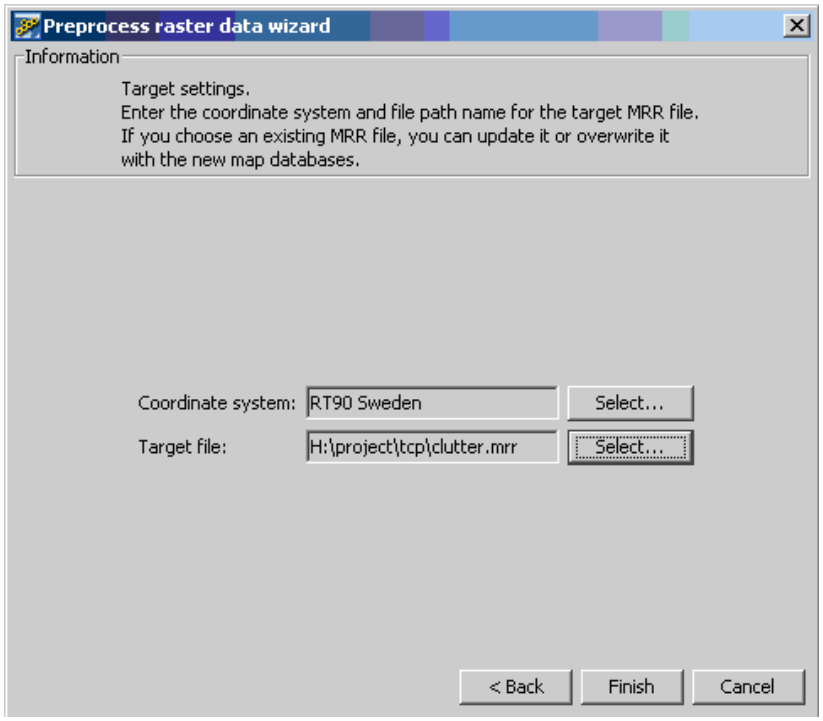
6. Select coordinate reference system, see Transform Map Data on page 4-25.
7. Click **Next**. If you have selected the Advanced option, two buttons **Raise** and **Lower** appear, so you can change the order of appearance of the layers, and select which layer to align with.

8. You can now change the alignment and order. The **Preprocess raster data wizard** is updated at the left side of the window, as follows:



9. If required, change the alignment resolution in the **Align with** column. Read about alignment in Alignment of Multiple Resolutions on page 8-8.

10. Click **Next**. A window is displayed so you can select a coordinate system and file path name for the target MRR file, as in the following example:



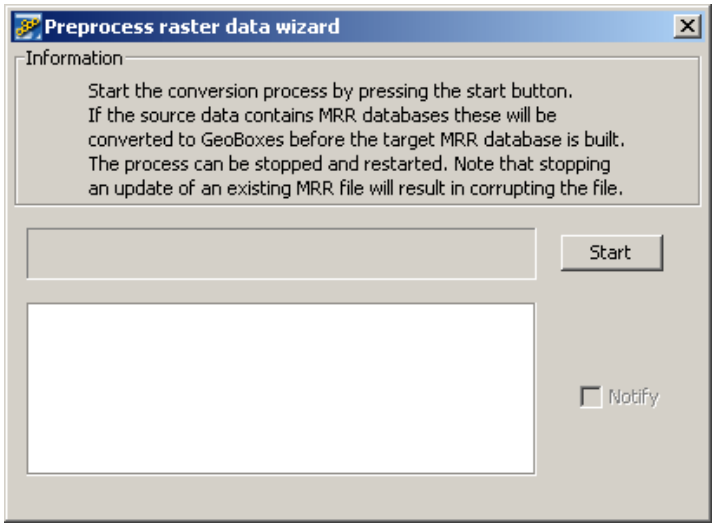
11. Select the target coordinate system from the list of predefined coordinate reference systems. By default the coordinate system of the source database is selected and displayed. You may choose a different coordinate system than the one used in the source data.

12. Select the location for the target MRR database. Enter a name for a new target file or select an existing file. A new file automatically has the extension *.mrr*.

    If you select an existing file, you have these options:

    - **Overwrite**: The contents of the existing file are deleted entirely, and the result is the same as if it was a new file.
    - **Update**: The contents of the existing file are updated with new data. Valid areas from the source data will overwrite corresponding areas in the target file. The existing data outside these areas remain intact.

13. Click **Finish**. The following window is displayed:



14. Optionally select **Notify** to be notified according to the Notification Settings when the import completes.
15. Click **Start** to begin the conversion. The window displays the status of the conversion process. All source map data is converted to the selected MRR target file.
16. It is recommended to store a text file together with the MRR database describing the original raster databases and the coordinate reference system used in the MRR database.
17. Repeat the procedure for all raster databases.

Convert Vector or Text Data to MRV

The preferred method for conversion of to MRV is **preprocessing** with the **Preprocess vector data** tool.

Example: Preprocess Planet DMS Vector Data, Convert to MRV.

Exception: To convert vector data with demographics to MRV, see instead Convert Vector or Text Data to MRV.

See also:

- Required and Recommended Map Formats on page 3-3 about reasons to convert to MRV.
- Supported Map Data Formats on page 8-2 for a complete survey of source and target map formats.
- Advanced Importing on page 4-5, an alternative method allowing **import** to GeoBox and selecting MRV as target format.

Preprocess Planet DMS Vector Data, Convert to MRV

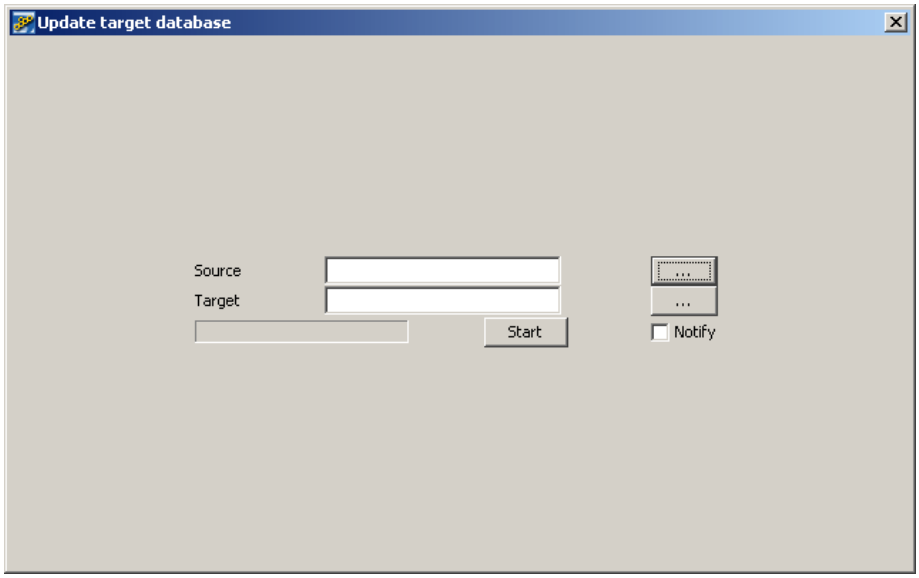
This example shows how to convert Planet DMS vector map data to MRV.

Prerequisites

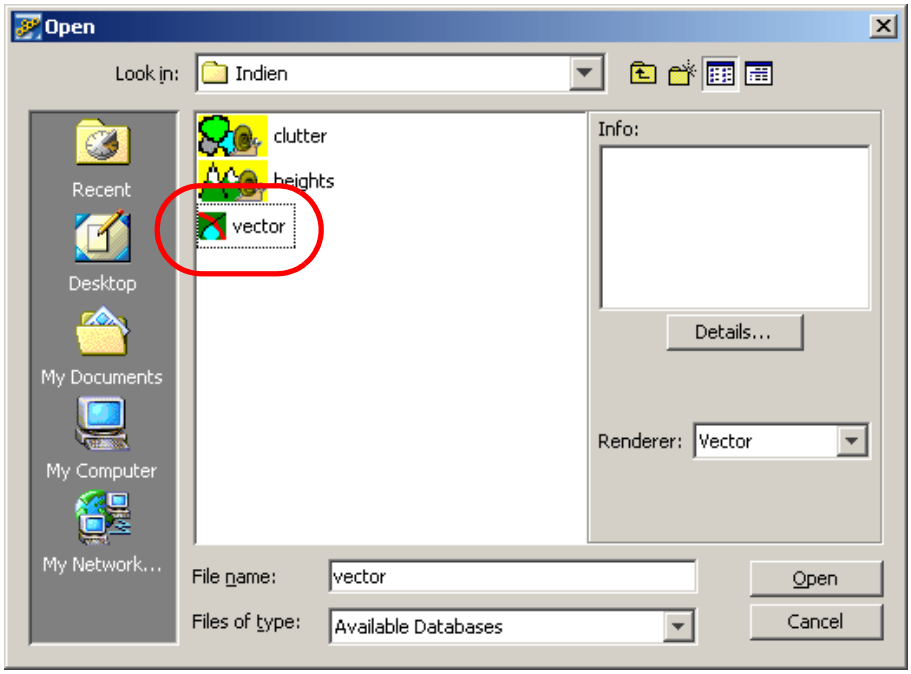
- The source data to convert to MRV must be possible to open as source database, otherwise you must first perform Advanced Import of Map Data.
- If your source database is of format Planet DMS, she folders must be correctly named, see Planet DMS (EET/Planet) and Asset Folder Naming Rules on page 8-7

Procedure

1. Select **File↗Map data↗Preprocess vector data**. The **Update target database** window is opened as in the following example:



2. Select the source vector database of type vector or text. You know that the map data is possible to preprocess if the folder name is preceded by a vector map type icon, as in the following example:



3. Select the location for the target MRV database. Enter a name for a new target file or select an existing file. A new file automatically has the extension *.mrv*.

   If you select an existing file it will be overwritten.

4. Optionally select **Notify** to be notified according to the Notification Settings when the import completes.

5. Click **Start.** If the map data does not have any associated coordinate reference system, the **Select map coordinate system** is opened.

6. Select coordinate reference system for the target MRV database and click **OK**. The **Select map coordinate system** window is closed and the conversion begins. A progress bar displays the status of the conversion.

7. When the conversion is successfully completed, the number of converted objects are displayed.

8. Repeat the procedure for all vector databases to convert to MRV.

Convert Demographic Data to MRR

Demographic data, also called demographics, are valuable planning input about where users of a certain radio technology are located, and which services and bit rates they might be interested in. Demographics can be based on marketing polls or assumptions, and may be included in acquired map data, or entered manually by the TEMS CellPlanner map data administrator.

The current version of TEMS CellPlanner supports display of demographics in MRR format, but demographics are not yet considered in predictions.

Use the **Preprocess demographic data** tool to convert demographics to MRR.

See also:

- Required and Recommended Map Formats on page 3-3 about reasons to convert to MRR.
- Supported Map Data Formats on page 8-2 for a complete survey of source and target map formats.

Demographic Data Preprocessing Scenarios

The foreseen import scenarios of demographic data are as follows:

A. Convert Vector Data with Demographics to MRR

This is the recommended scenario as it is accurate and time efficient, with demographics already embedded in the source data by the vendor.

In this scenario you import multi-attribute vector source files where each source file includes one or more demographic attributes (like age, income, mobility) with numeric values representing number of individuals per square kilometer. During preprocessing, you map selected attributes to demographic categories.

Contact TEMS Support for information on how to acquire map data including demographics.

Example: Convert MapInfo MIF/MID with Demographics to MRR.

B. Translate Raster Data to Demographics, Convert to MRR

This is an alternative scenario to the recommended one. It is cheaper but requires more effort by the map data administrator and is probably less accurate as you must manually enter the demographic data or rely on default values.

Here you use single-valued raster source database, where each source database includes one qualitative raster data type with values possible to translate into a population density of a certain demographic category. TEMS CellPlanner automatically maps the raster data values into number of individuals per square

kilometer. You can edit the mapping if you are not satisfied with the default settings.

Example: Translate Landuse Codes to Demographics, Store as MRR

Convert MapInfo MIF/MID with Demographics to MRR

This example shows conversion of MapInfo MIF/MID vector data including demographic data to MRR format.

Prerequisites

- You have access to multi-attribute vector source files.
- The source data already includes demographic attributes with values in number of individuals per square kilometer.
- If you will add imported source data to an already existing target database, you must find out the coordinate system and resolution of the target database, and reuse the same settings during preprocessing.

Process

The conversion wizard includes the following steps:

- Part I: Select Source Data
- Part II: Define Target Parameters
- Part III: Assign Category
- Part IV: Update Target Database

Part I: Select Source Data

Do as follows to select the source data including demographic data attributes:

1. Select **File↗Map data↗Preprocess demographic data**... to display the **Preprocess demographic maps wizard** window.
2. Click **Source Files** to open the **Open map file(s)** window.
3. Select the vector map type source file(s) including demographic data. If you select more than one source file they must all be of the same map type, otherwise you can not proceed.
4. Click **Open**. The wizard window lists the selected database(s).
5. To view available attributes, highlight the source data, click **View** and select tab **File structure**. You will later map these attributes to categories visualized in the map display.
6. Click **Next**.

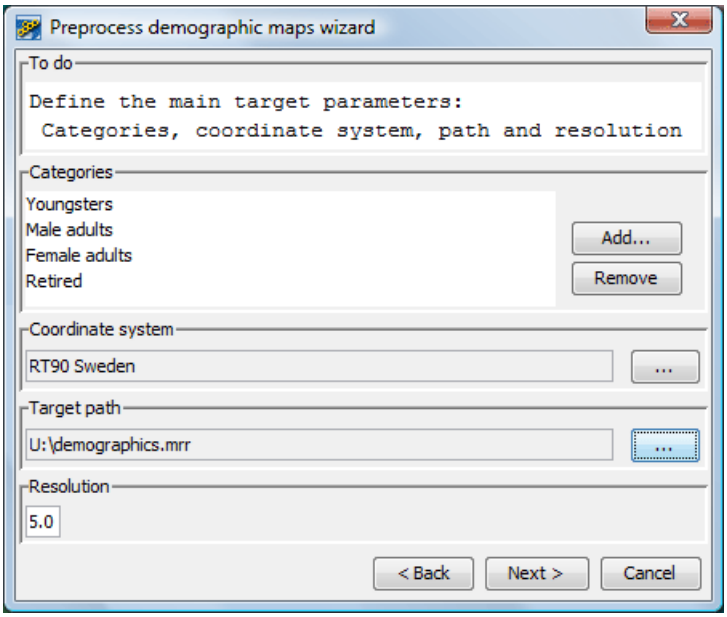
Part II: Define Target Parameters

All target parameters must be defined, you can otherwise not proceed. Do as follows to define the target parameters:

7. The wizard window initially displays the demographic categories used in previous runs of the wizard and the coordinate system of the source data.
8. Add or remove **Categories** as desired.
9. Select target **Coordinate system**, see Transform Map Data.
10. Click on ... at the **Target path**, browse to the folder where the target data shall be placed, enter the target file name, and click **Open**. The wizard window is updated with the target path.
11. Enter a **Resolution** and press **TAB**.

Note: *If the imported data will be added to an existing target database, the target resolution will not be changed whatever you enter here.*

12. The result might look as in the following example:



13. Click **Next**.

Part III: Assign Category

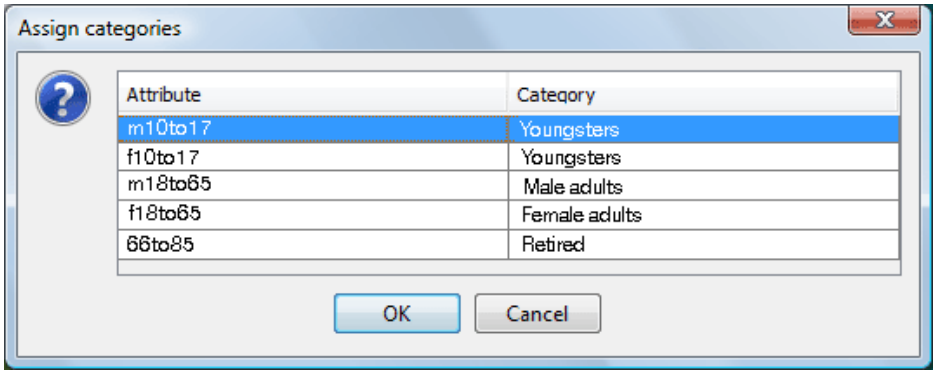
Do as follows to assign a category to each source file:

14. The wizard window displays a list of selected source data and an empty default category column.

15. For each source data, click in its **Default category** field to list available categories, and select a default category. You may select different categories for different source data. You must select a default category for each source data, otherwise you cannot proceed.

    The default category will appear on the map display the first time you include this demographics as a map layer.

16. Click **Edit** and assign each attribute in the source data to a category as in the following example:

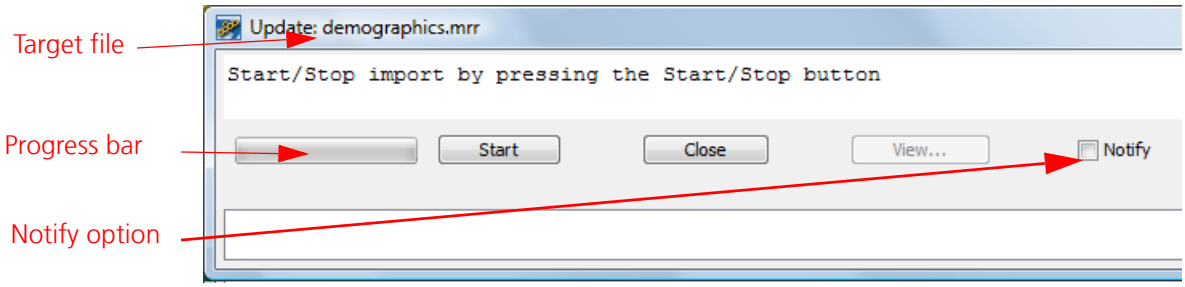


17. Click **OK** to return to the wizard window.
18. Click **Finish**.

Part IV: Update Target Database

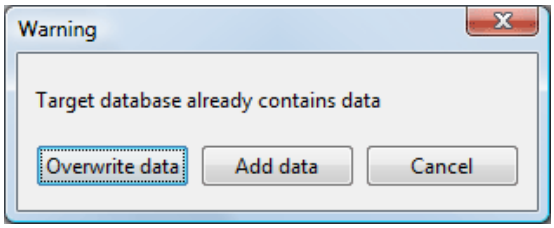
Do as follows to update the target MRR database with the demographic data.

19. After the previous step, the **Update** window was displayed:



20. Optionally select **Notify** to be notified according to the Notification Settings when the import completes.

21. Click **Start** to begin the conversion. If the target database already exists the following warning is displayed:



22. Select the appropriate choice. If you overwrite data, the original target database is first copied to a backup file in the same folder.
23. The window displays the conversion progress. All map data is converted to MRR and saved in the target database.
24. To examine the converted data, click **View**. See View Map Data.
25. It is recommended to store a text file together with the MRR database. This text file should describe the source raster data and the coordinate reference system used in the target MRR database.

You can now include demographic data as a map layer on the map display.

Translate Landuse Codes to Demographics, Store as MRR

This example shows how to translate landuse codes into individuals per square kilometer and store in MRR format.

Prerequisites

- The source data to convert to MRR must be possible to open as single-valued raster source database. If your source data is not structured as source database you must first perform Advanced Import of Map Data.
- If you will add imported source data to an already existing target database, you must find out the coordinate system and resolution of the target database, and reuse the same settings during preprocessing.

Process

The conversion wizard includes the following steps:

- Part I: Select Source Data
- Part II: Define Target Parameters
- Part III: Assign Category and Translate to Demographics
- Part IV: Update Target Database

Part I: Select Source Data

Do as follows to select the source data to translate to demographic data:

1. Select **File↗Map data↗Preprocess demographic data**... to display the **Preprocess demographic maps wizard** window.
2. Click **Source DB** to open the **Open database** window.
3. Select the raster map type database(s) to use as source. If you select more than one source database they must all be of the same map type, otherwise you can not proceed.
4. Click **Open**. The wizard window lists the selected database(s).
5. Click **Next**.

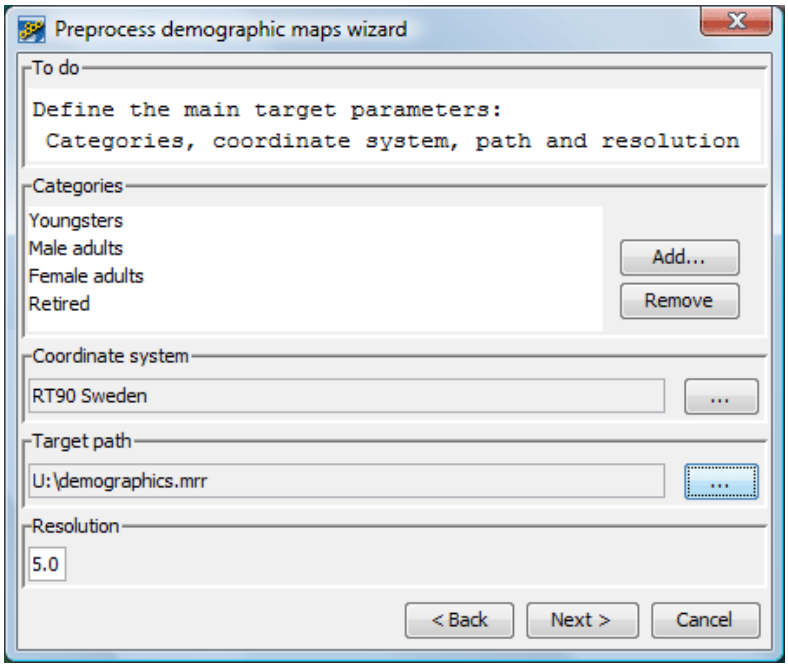
Part II: Define Target Parameters

All target parameters must be defined, you can otherwise not proceed. Do as follows to define the target parameters.

6. The wizard window initially displays the demographic categories used in previous runs of the wizard, the coordinate system of the source data, and the finest resolution of the source data.
7. Add or remove **Categories** as desired.
8. Select target **Coordinate system**, see Transform Map Data.
9. Click on ... at the **Target path**, browse to the folder where the target data shall be placed, enter the target file name, and click **Open**. The wizard window is updated with the target path.
10. Optionally modify the **Resolution** and press **TAB**.

Note: *If the imported data will be added to an existing target database, the target resolution will not be changed whatever you enter here.*

11. The result might look as in the following example:



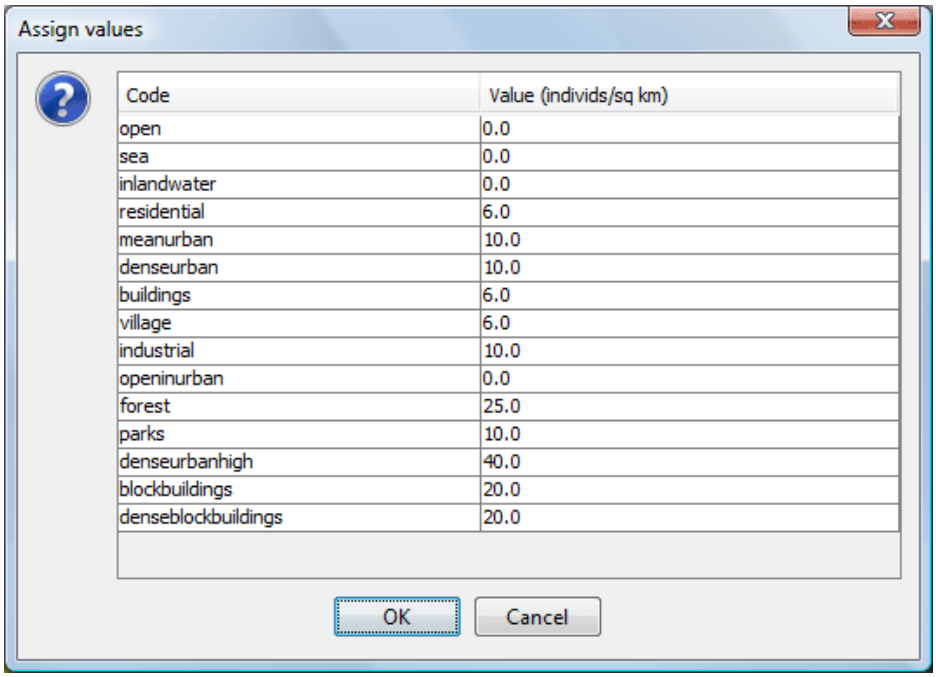
12. Click **Next**.

Part III: Assign Category and Translate to Demographics

Do as follows to assign a category to each database and view/edit the demographic data:

13. The wizard window displays a list of selected source data and an empty category column.
14. For each source data, click in its **Category** field to list available categories, and select a category. You may select different categories for different source data. You must select a category for each source data, otherwise you cannot proceed.

15. Click **Edit** to view the default mapping of raster data value to corresponding demographic data value, in this example landuse code translated to number of individuals per square kilometer:



16. Modify the values if needed and click **OK** to return to the wizard window.

Note: *The values you enter will be included in the target MRR file even if you cannot view them. If you select **Edit** again, you will reload the default values and lose the values you just entered.*

17. Click **Finish**.

Part IV: Update Target Database

See Part IV: Update Target Database on page 4-19.

Advanced Import of Map Data

TEMS CellPlanner can only use map data for display and predictions if the source data meets the requirements in Required and Recommended Map Formats.

Besides the straight-forward and easy-to-use **preprocessing** tools, you can - and in some cases must - use the **import** tool described in the *TEMS CellPlanner Map Import Wizard User's Guide*.

Refer to Tools for Import of Map Data on page 4-3 for an overview and comparison of the tools, and for information on what kind of source data that must be imported using the **import** tool.

Transform Map Data

You might need to change coordinate system and optionally shift geodetic datum of your map data. This is called transformation or reprojection.

The main reason to transform the map data is to apply the same coordinate system to different source data, merged into the same MRR target.

Note that the target coordinate system selected here:

- will be used in predictions
- will not be used on the map display

The map display uses the coordinate system in your Project settings. See chapter *"Setting up Projects"* in the *TEMS CellPlanner Common Features User's Guide*.

Prerequisites

If the source data is geographic, you shall maintain the unprojected coordinate reference system during the import. Example: Starting with SRTM map data with WGS-84 (LoLa) coordinate reference system, you first convert it by import and convert to GeoBox, still with WGS-84 (LoLa). In the next step you preprocess the GeoBox WGS-84 (LoLa) and transform it to MRR WGS84-UTM.

Reasons to Select or Not Select Coordinate System

- If the source database is of map format *Planet DMS* you must select a coordinate system.
- If the source database is of map format *GeoBox*, do not select a coordinate system for it, since this info is already in the GeoBox database.
- All other map formats must have a coordinate system.
- If the source data shall be added to an already existing target, you must select the same coordinate system as in the target.
- If you have selected source databases with different coordinate systems, you do not need to take any action. The source databases are automatically reprojected to the coordinate system of the target database.

Procedure

1. Initiate Preprocessing Raster Data, Preprocessing Demographic Data or Advanced Importing.
2. Select target coordinate system if needed, see Reasons to Select or Not Select Coordinate System.

3. The **Select map coordinate system** window is displayed as in the following example:

4. With **Use UTM reference system** selected, you can also change the geodetic datum.
5. Select **DMS** representation if desired.
6. Click **OK** to close the window.
7. Proceed with the preprocessing or advanced import.

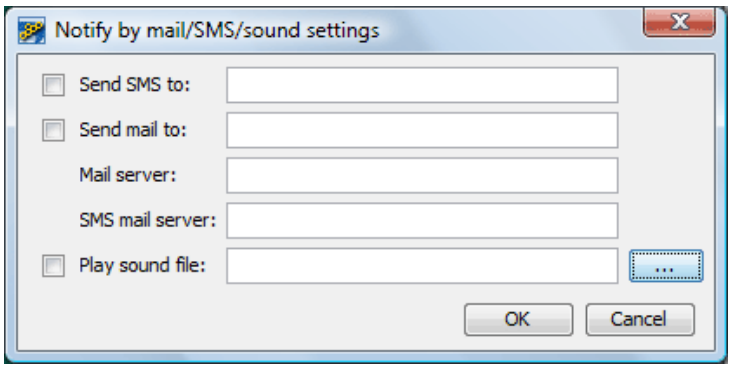
Notification Settings

Instead of waiting for map data import or export to complete, you can select to be notified at completion by SMS, e-mail or a sound, or a combination of those notification methods.

Select Notification Method

Do as follows to select notification method:

1. Select **File↗Map data↗Notification settings...** to open the **Notify by mail/SMS/sound settings** window:



2. To be notified by SMS, select the option **Send SMS to**, enter the phone number, and the **SMS mail server** name or IP address.
3. To be notified by e-mail, select the option **Send mail to**, enter the e-mail address and the **Mail server** name or IP address.
4. To be notified by a sound, select the option **Play sound file** and enter or browse the file name of the sound file.
5. Click **OK**. The notification settings are saved persistently.

Enable Notification at Import

As a last step in the Tools for Import of Map Data you can select option **Notify** to be notified when the import completes. You will then be alerted according to your settings in Select Notification Method.

5
Customizing Coordinate Systems

This chapter describes how to create and configure geodesy objects such as coordinate systems, datums and ellipsoid for datums.

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About Coordinate Reference Systems and Projections

A *coordinate system object* in TEMS CellPlanner is associated with a datum, in its turn associated with an ellipsoid. Together these objects are referred to as a *map coordinate reference system* or *geographic reference system*, which controls the way coordinates are transformed from one map to another. A coordinate reference system is defined by its name, geodetic datum and description of the map projection.

Every map is associated with a projection and a spheroid called *geodetic datum*. Geodetic information must exist so the map can be used where coordinates are required in latitude and longitude.

Since maps on paper or screen are always flat, coordinate systems must be two-dimensional. The real world is more complicated. The earth is almost a sphere but to accurately transform a map's coordinates to a global spherical system, the earth is usually modeled as a rotational ellipsoid.

Modeling the Earth in Coordinate Reference Systems

A coordinate reference system models the earth with parameters and algorithms to transform it to or from a global coordinate reference system. For example, WGS84 is used for GPS to transform global coordinates to or from coordinates on a map.

The earth is modelled in a number of steps. The authorities responsible for mapping perform these tasks:

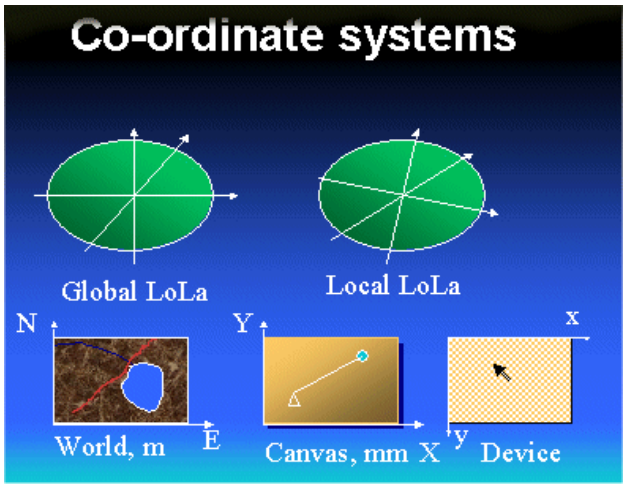
1. Establish the geoid, that is, the mean water surface, at the area of interest
2. Find an ellipsoid among a limited number of established ellipsoids that best fits the geoid at the area of interest.
3. Place the selected ellipsoid to minimize the differences over the geoid within the area of interest.
4. Select a map projection among a limited number of established projections. The projection transforms the geometry on the curved area on the ellipsoid to a plane suitable for two-dimensional media such as maps and computers.
5. Select projection parameters to minimize specific errors within the area of interest.

Tasks 1-3 are usually referred to as establishing geodetic datum. This deals with transformation of longitude and latitude between different geodetic datums, called datum shift.

Steps 4-5 set the map projection, that is, the transformation from longitude and latitude on an ellipsoid to or from cartesian coordinates in a plane.

Coordinate Reference Systems Used in TEMS CellPlanner

The coordinate reference systems used by TEMS CellPlanner are as follows:



The coordinate reference systems are in TEMS CellPlanner classified as either of:

- Global LoLa
- Local LoLa
- World
- Canvas
- Device

Global LoLa

Global LoLa coordinates are measured from satellites using GPS, or iGPS for the WGS84 case. The most commonly used Global LoLa coordinate reference systems are as follows:

- Latitude, Longitude, Height
- Universal Transverse Mercator (UTM)
- Military Grid Reference System (MGRS)

Local LoLa

Local LoLa coordinates are measured locally on earth using sextants or similar equipment. The Local LoLa coordinate reference systems are as follows:

- Universal Polar Stereographic (UPS)
  The UPS projection latitudes are defined north of 84 degrees north and south of 80 degrees south. The eastings and northings are computed using a polar

aspect stereographic projection. Zones are computed using a different character set for south and north Polar regions.

- National Grid Systems
  Many nations have defined grid systems based on coordinates that cover their territory. Australia, Belgium, Great Britain, Finland, Ireland, Italy, the Netherlands, New Zealand, and Sweden are a examples of nations that have defined a National Grid System.

World

The World coordinate reference system is an upscale from Canvas.

The World Geographic Reference System (GEOREF) is used for aircraft navigation. GEOREF is based on latitude and longitude. The globe is divided into 12 bands of latitude and24 zones of longitude, each 15 degrees wide.

Canvas

For example a "paper map".

Device

For example a monitor or a printer.

Supported Projections

TEMS CellPlanner supports the following map projections:

- Albers Equal Area
- Azimuthal Equidistant
- BirdsViewProjection
- Cassini cylindrical
- Geographic (that is, without a projection)
- Hungary EOV
- Lambert Conic Conformal, 1 std parallel
- Lambert Conic Conformal, 2 std parallel
- New Zealand map grid
- Oblique Mercator, Central line defined by azimuth at point of origin
- Oblique Mercator, Central line defined by two points
- Polyconic
- Regular Mercator
- Stereographic

- Stereographic Polar (known parallel), 1st std parallel
- Stereographic Polar (known scale)
- Swiss Projection
- Transverse Mercator

Coordinate Systems

Each map in a TEMS CellPlanner project must have a coordinate system.

Add Coordinate System

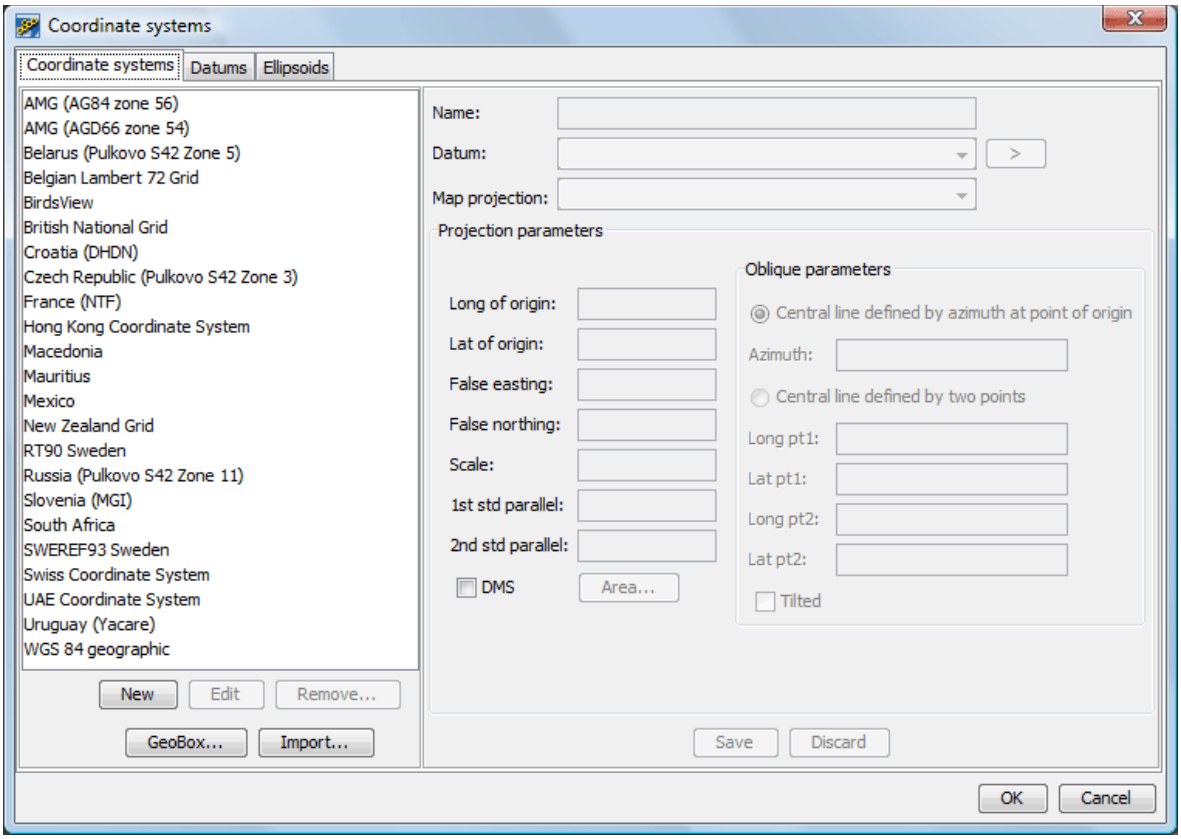
Use this procedure to add coordinate systems.

Prerequisites

A project is opened.

Procedure

1. Select **File↗Map data↗Coordinate systems↗EriMap**, and select the tab **Coordinate systems**. The available coordinate systems with parameters are displayed, see Fields on Window "Coordinate systems", as in the following example:



2. *Optional*: To base the new coordinate system on an existing one, highlight the coordinate system to copy from the list. The parameters of the selected coordinate system are displayed.
3. Click **New**. The parameters of a new coordinate system are displayed.
4. Enter a name of the coordinate system.
5. Select geodetic datum from the list.
6. Select map projection from the list.
7. Click **Save** to create and persistently save the coordinate system. The created coordinate system appears in the list.

Fields on Window “Coordinate systems”

Field	Description
Coordinate systems	List of defined coordinate systems. The name of the selected coordinate system is highlighted.
New	Creates a temporary coordinate system with the same parameters as the currently selected one
Edit	Makes changes to the selected coordinate system.
Remove	Removes the selected coordinate system.
GeoBox	Selects a generic GeoBox database to use for creating a new coordinate system.
Import	Selects XML files with correct attributes. When the file is selected, the import starts.
Name	Name of the selected coordinate system.
Datum	Geodetic datum associated with the coordinate system.
>	Opens the **Datums** window with the selected datum.
Map projection	Map projection used with the coordinate system.
Projection parameters - Projection type dependent parameters of the coordinate system	
	Long. of origin - Longitude of origin
	Lat. of origin - Latitude of origin
	False easting - in meters
	False northing - in meters
	Scale
	1st std parallel
	2nd std parallel
	DMS - Use DMS (DegreesMinutesSeconds), decimal or sexagecimal representation of angular parameters
	Area - Opens the **Global area** window with N/E/S/W
Oblique parameters - Projection type dependent parameters of the coordinate system	
	Central line defined by azimuth at point of origin
	- Azimuth
	Central line defined by two points
	- Long pt1
	- Lat. pt1
	- Long. pt2
	- Lat. pt2
	Tilted - the axes are aligned with the central line and not with North / East
Save	Saves additions and changes persistently
Discard	Discards changes

Modify Coordinate System

1. Select **File↗Map data↗Coordinate systems↗EriMap**, and select the tab **Coordinate systems**. The available coordinate systems with parameters are displayed, see Fields on Window "Coordinate systems".
2. Select a coordinate system from the list. The parameters of the selected coordinate system are displayed.
3. Click **Edit**. Modify the parameters as required.
4. Click **Save** to persistently save the changes.

Delete Coordinate System

1. Select **File↗Map data↗Coordinate systems↗EriMap**, and select the tab **Coordinate systems**. The available coordinate systems with parameters are displayed, see Fields on Window "Coordinate systems".
2. Select the coordinate system to delete from the list.
3. Click **Remove**. The coordinate system disappears from the list.

Advanced Use of Coordinate Systems

All information about coordinate systems, projection, datum and ellipsoid are stored in an XML file. This file is specified in the EriMap.resources file with the key Map_Reference_Systems.CoordinateSystemsFile. This file may be write protected to prevent unintentional changes but the write protection can be removed from inside the application. The file may be updated via GUI and/or import from a file.

Calculating Geographic Relative Coordinates

If a position is given in map coordinates (world) X/Y relative to a reference position, dX/dY, to find the geographic relative coordinates, you can use the following formulas. The reference position is given in Lo/La (longitude/latitude in degrees).

```
dLo = dx / a 180 / Pi /cos(La);
dLa = dy / a 180 / Pi;
```

Where *a* is the earth's radius approximately 6370000 m, Pi is 3.1415.

This formula does not consider the actual projection and may be accurate typically only to 10-20%.

For an accurate calculation, you must know the map projection use a projection tool such as CoordTrans2.

Note: *The relative geographic coordinates are invalid if the reference positioned is changed.*

Datums for Coordinate Systems

A datum provides orientation to the actual center of the Earth, using the geodetic datum position and orientation parameters. It is defined by its name, an ellipsoid, and the parameters used to shift datum to or from WGS84 according to Bursa-Wulf. See Ellipsoid/Spheroid and Datum on page 2-4.

Add Datum

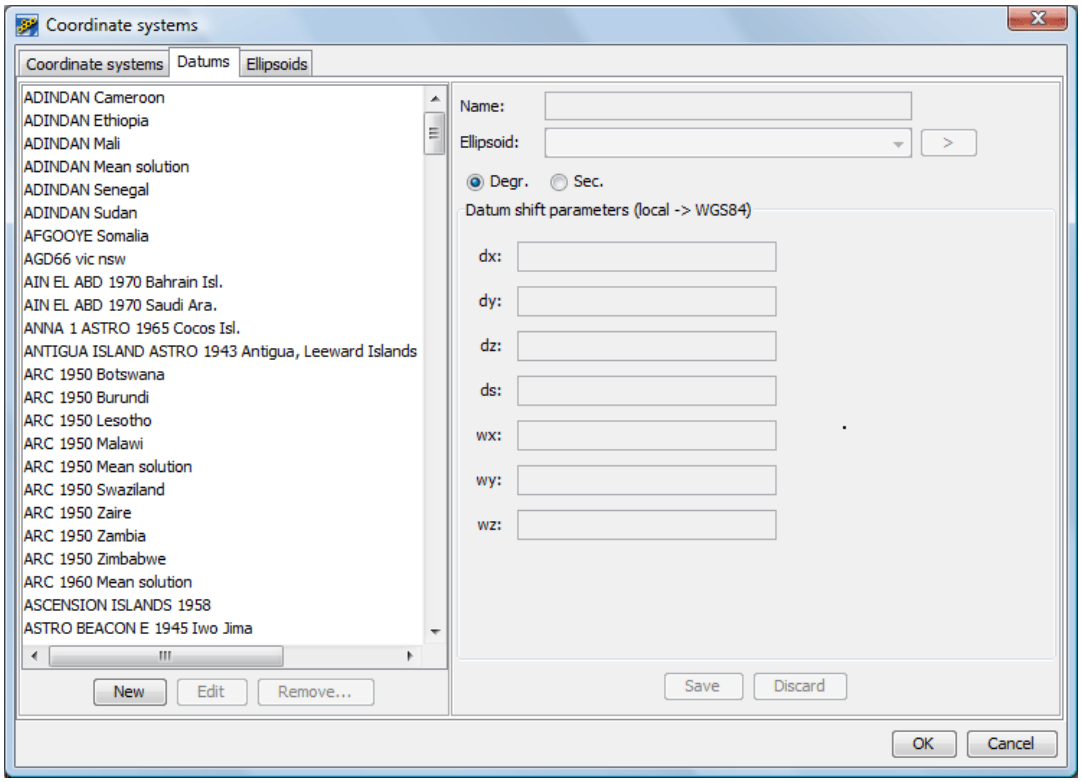
Use this procedure to add datums for map coordinate systems.

Prerequisites

A project is opened.

Procedure

1. Select **File↗Map data↗Coordinate systems↗EriMap**, and select the tab **Datums**. The available datums with parameters are displayed, see Fields on Window "Datums", as in the following example:



2. *Optional*: To base the datum on an existing one, highlight the datum to copy from the list. The parameters of the selected datum are displayed.

3. Click **New**. The parameters of a new datum are displayed.
4. Enter a name of the datum.
5. Select an ellipsoid from the list.
6. Modify the other parameters as required.
7. Click **Save** to create and persistently save the datum. The datum appears in the list.

Fields on Window "Datums"

Field	Description
Datums	List of defined geodetic datums.
New	Creates a temporary datum with the same parameters as the currently selected one
Edit	Changes datum parameters
Remove	Deletes a datum from the list
Name	New name for the defined geodetic datum
Ellipsoid	Ellipsoid used with the selected datum
>	Opens the **Ellipsoids** window of the selected ellipsoid
Degr.	Uses degrees as the unit of measurement for the datum shift parameters
Sec.	Uses arc of seconds as the unit of measurement for the datum shift parameters
Datum shift parameters	**dx**: Translation in X (m).
	dy: Translation in Y (m).
	dz: Translation in Z (m).
	ds: Scale factor deviation.
	wx: Rotation around x-axis in decimal degrees or arc of seconds.
	wy: Rotation around y-axis in decimal degrees or arc of seconds.
	wz: Rotation around z-axis in decimal degrees or arc of seconds.
Save	Saves additions and changes persistently
Discard	Discards changes

Modify Datum

Use this procedure to modify datums for map coordinate systems.

Prerequisites

The datum to modify is not used by any coordinate system.

Procedure

1. Select **File↗Map data↗Coordinate systems↗EriMap**, and select the tab **Datums**. The available datums with parameters are displayed, see Fields on Window "Datums".
2. Select a datum from the list. The selected datum parameters are displayed on the right.
3. Click **Edit**. If the selected datum is in use by some coordinate system, a warning message is displayed and you cannot change the datum.
4. Click **Save** to persistently save the changes.

Delete Datum

Use this procedure to delete datums for map coordinate systems.

Prerequisites

The datum to delete is not used by any coordinate system.

Procedure

1. Select **File↗Map data↗Coordinate systems↗EriMap**, and select the tab **Datums**. The available datums with parameters are displayed, see Fields on Window "Datums".
2. Select the datum to delete from the list.
3. Click **Remove**. The datum disappears from the list.

   If the selected datum is used by one or more coordinate systems, a warning message is displayed and the datum is not deleted.

Ellipsoids for Datums

An ellipsoid is a surface obtained by rotating an ellipse around one of its axes. In cartography, the shape of the Earth can be considered an ellipsoid. The Earth is not a perfect ellipsoid, so numerous ellipsoid models have been adopted to approximate the surface of different parts of the Earth.

They are slightly different in shape and size are defined uniquely by their equatorial and polar radii, semi major and semi minor axis. They are identified by names related to their inventors and the year of invention, such as Clarke-1866 and International-1924.

The table below lists the names and radii of some commonly used ellipsoids:

Name	Semi-Major	Semi-Minor
Airy 1849	6377340	6356034
Bessel 1841	6377397	6356079
Clarke 1880	6378249	6356515
Everest 1830	6377276	6356075
GRS 80 (identical to WGS-84)	6378137	6356752
International 1924 (Hayford)	6378388	6356912
Krassovsky 1940	6378245	6356863
SAD 69/ANS	6378160	6356775
WGS 72	6378135	6356751

Read more about ellipsoids in Ellipsoid/Spheroid and Datum on page 2-4.

Add Ellipsoid

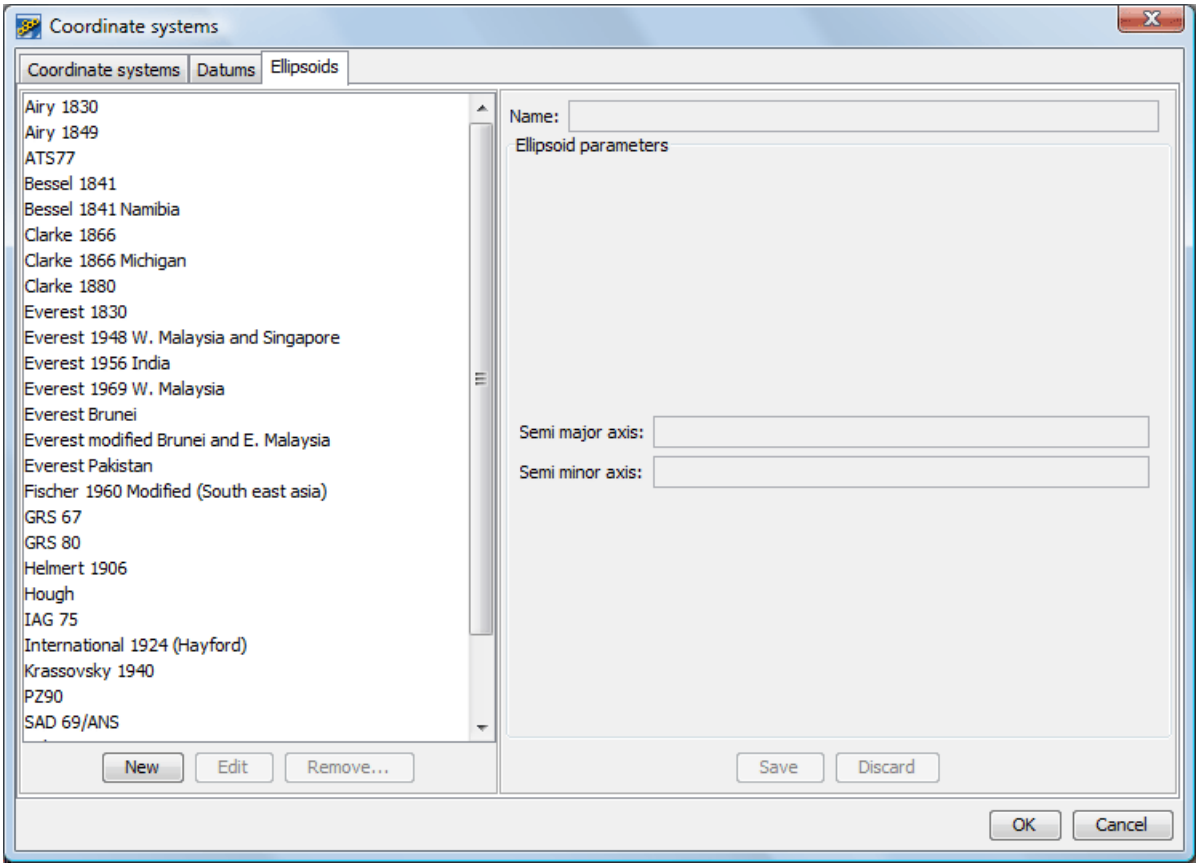
Use this procedure to add ellipsoids for datums.

Prerequisites

A project is opened.

Procedure

1. Select **File↗Map data↗Coordinate systems↗EriMap**, and select the tab **Ellipsoids**. The available ellipsoids with parameters are displayed, see Fields on Window "Ellipsoids".



2. *Optional*: To base the ellipsoid on an existing one, highlight the ellipsoid to copy from the list. The parameters of the selected ellipsoid are displayed.
3. Click **New**. The parameters of a new ellipsoid are displayed.
4. Enter a name of the ellipsoid.
5. Modify the axis parameters as required.
6. Click **Save** to create and persistently save the ellipsoid. The ellipsoid appears in the list.

Fields on Window "Ellipsoids"

The following table describes the fields on the window:

Field	Description
Name	Name of the ellipsoid
Semi major axis	Unique semi-major axis of the ellipsoid.
Semi minor axis	Unique semi-minor axis of the ellipsoid.
Save	Saves additions and changes persistently
Discard	Discards changes

Modify Ellipsoid

Use this procedure to modify ellipsoids.

Prerequisites

The ellipsoid to modify is not used by any datum.

Procedure

1. Select File↗Map data↗Coordinate systems↗EriMap, and select the tab Datums. The available datums with parameters are displayed, see Fields on Window "Ellipsoids".
2. Select an ellipsoid from the list. The selected ellipsoid parameters are displayed on the right.
3. Click Edit. If the selected ellipsoid is in use by some datum, a warning message is displayed and you cannot change the ellipsoid.
4. Click Save to persistently save the changes.

Delete Ellipsoid

Use this procedure to delete ellipsoids.

Prerequisites

The ellipsoid to delete is not used by any datum.

Procedure

1. Select File↗Map data↗Coordinate systems↗EriMap, and select the tab Ellipsoids. The available ellipsoids are displayed, see Fields on Window "Ellipsoids".

2. Select the ellipsoid to delete from the list.
3. Click **Remove**. The ellipsoid disappears from the list.

   If the selected ellipsoid is used by one or more datums, a warning message is displayed and the ellipsoid is not deleted.

6
Exporting Map Data

This chapter describes how to export map data from TEMS CellPlanner.

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Export Map Data 6-2
Export Sites to Google Earth 6-5

Export Map Data

You can export map layers from the map display, for example to save plots.

See Supported Map Data Formats on page 8-2 for a complete survey of possible target formats for the export.

Export Conversions

Some export scenarios include conversion, for example the following:

- Pathloss layer exported to MIF/MID: raster to vector
- Pathloss layer exported to Google Earth: raster to image
- Pathloss layer exported to ASCII Grid: raster to raster
- Network layer exported to TAB: vector to vector

Limitations

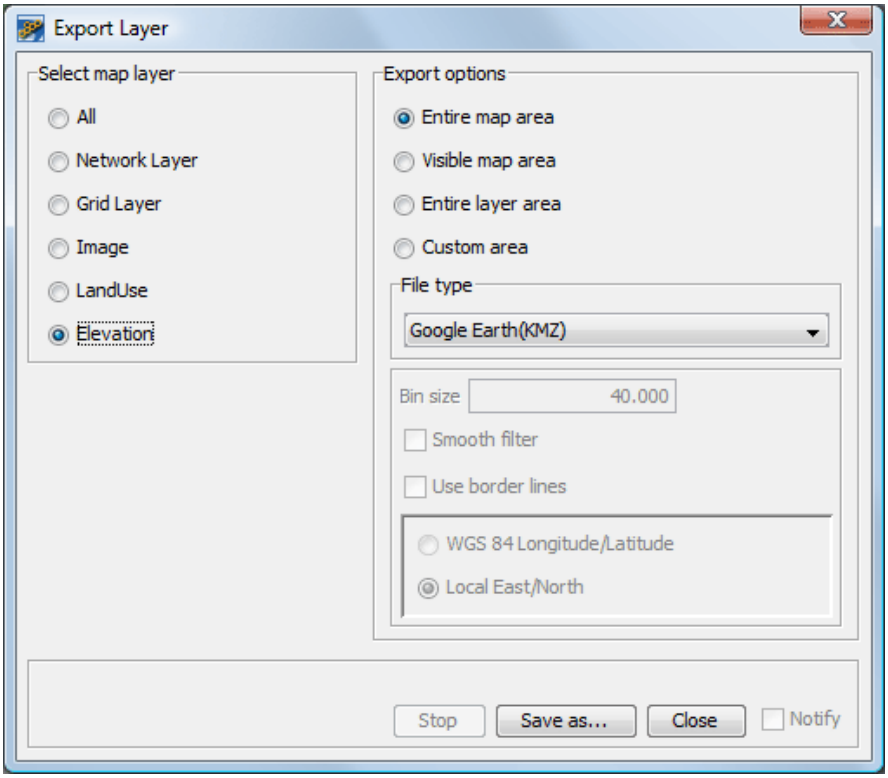
- Polygon information might get lost during the export, resulting in white spots in the target map data.
- If you export to *TAB* format from a computer using *64 bits JVM*, you can not display this map data if re-imported in a computer using 64 bits JVM. It is still possible to display if imported in a computer using 32 bits JVM. See Do TEMS CellPlanner Clients use 32 Bits or 64 Bits JVM? on page 3-4.

Prerequisites

A project with loaded map layers is opened in TEMS CellPlanner.

Procedure

1. Select **Map↗Export layer...** The **Export Layer** window appears, with the layers included in the **Map properties**, as in the following example:



2. Select to export one map layer, or **All** map layers. Depending on your selection different export options become available.
3. Select the desired **Export options**.
4. Select the **File type** for the exported data.
5. Select desired export features such as **Smooth filter** and **Use border lines**.
6. Select **Local East/North** to export using the same coordinate system as in the project settings.

Note: *Your map data will be transformed if you select WGS 84 Longitude/Latitude. Transforming increases the risk for lost polygon information.*

7. Click **Save as**... to open a browser.
8. Select the target file name and click **Save**. The export initiates and the progress is displayed in the browser window.
9. A dialog appears when the export is completed.
10. Click **Close** to close the window.

Fields on the Export Layer Window

Field	Description
Select map layer	Lists the loaded map layers as they appear in the **Map properties** window, starting with an entry for **All** layers: • All • Grid • Elevation • ...
Export options	Delimits the geographical area to export: • Entire map area - entire project • Visible map area only - visible in window • Entire layer area • Custom area. If selected, a window allowing you to modify the N/S/W/E borders appear.
File type	The possible target formats, depending on selected map layer: • Google Earth 3D • Google Earth • TAB • XYZ-raster (ASC) • MapInfo (MIF/MID) • TIFF (TIF+TFW+TAB) • JPEG (JPG+TFW+TAB) • BMP (BMP+TFW+TAB) • Grid (GRD) See Supported Map Data Formats on page 8-2 for more information on the map formats.
Bin size	Bin size of the map layer to export. Valid only for raster based map layers, for example pathloss.
Smooth filter	Filters the contours during export. Valid only for export from raster to vector format.
Use border lines	Saves map area border lines in a separate color. Valid only for export from raster to vector format.
WGS 84 Longitude/ Latitude	Use the coordinates in longitude and latitude of WGS-84 geodetical datum. Valid only for some target formats (file type).
Local East/North	Use coordinate reference system defined for the project. Valid only for some target formats (file type).
Save as...	Opens a browser allowing you to select the destination folder of the exported map data. The export starts when you click **Save** in this window.
Stop	Interrupts the export
Notify	Enables sending a notification when the export completes, according to the Notification Settings.

Export Sites to Google Earth

You can export sites in your network plan to a .kmz file which you can open in Google Earth.

Prerequisites

A project with a loaded network layer including sites is opened.

Procedure

1. Select Map↗Export sites to Google Earth... A browser window named Sites to Google Earth appears.
2. Enter or browse the name of the .kmz file to which you want to export the sites and click Save. All sites are exported to this file.

7
Migrating Map Data

This chapter describes the map data entities to migrate at upgrade to a new version of TEMS CellPlanner.

Topics **Page**

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Migrate Propagation Models 7-3
Migrate Traffic Density Maps 7-4
Migrate Pathloss Fading Tables 7-5
Migrate Coordinate Reference System 7-6

About Migration of Map Data

At upgrade to new version of TEMS CellPlanner, you must ensure that the MRR map databases work with projects imported from older versions of TEMS CellPlanner.

The migration tasks are described in detail in the chapter "Migrating to New Versions of Software" in the *TEMS CellPlanner Installation Guide*.

Migrate Propagation Models

TEMS CellPlanner propagation models use the **landuse codes** from the map data to assign **correction factors** used by the model in pathloss predictions.
If you use multi-resolution MRR databases, the correction factors may be a problem at migration.

Before upgrade, **you must manually record the used correction factors** before removing an older version of TEMS CellPlanner.

After upgrade, **you must check the correction factors** in the new version of TEMS CellPlanner.

There is no migration problem with correction codes if you only use single resolution MRR map databases.

For more information, see Modified Landuse Codes on page 8-8

Migrate Traffic Density Maps

If you create a multi resolution MRR map database, the **traffic load factors** may be incorrect because of the possible change in **landuse codes**.

Before upgrade, **you must manually record the used traffic load factors** before removing an older version of TEMS CellPlanner.

After upgrade, **you must check the traffic load factors** in the new version of TEMS CellPlanner.

There is no migration problem with traffic load factors if you only use single resolution MRR map databases.

Migrate Pathloss Fading Tables

Pathloss fading margins (Link UL and Link DL) will be correct if you create a single resolution MRR map database.

If you create a multi resolution MRR map database, the pathloss fading margins (Link UL and Link DL) might be incorrect because of the possible change in landuse code numbers.

Before upgrade, you must manually record the pathloss fading margins before removing an older version of TEMS CellPlanner.

After upgrade, you must check the pathloss fading margins in the new version of TEMS CellPlanner.

There is no migration problem with pathloss fading margins if you only use single resolution MRR map databases.

Migrate Coordinate Reference System

If the coordinate reference system used for the exported project does not exist in the Coordinates.xml file, it is created during the import and added to the list of existing coordinate reference systems. The used coordinate reference system can be displayed by clicking **View** in the **Project settings** window.

8
Appendix: GeoData Technical Reference

This chapter gives an overview of the map data formats supported in TEMS CellPlanner, with detailed description of some map data formats and naming rules. In addition, here you also find how multiple resolution map data is calculated from its source data.

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- Commercial Map Data Formats - Source Files 8-3
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Supported Map Data Formats

The map data of the formats listed in this section can be imported using the map tools in TEMS CellPlanner. Some formats require conversion to suitable format, other formats can be used as they are for predictions and viewing.

See Required and Recommended Map Formats on page 3-3 about which formats can be used in TEMS CellPlanner Clients without conversion.

See Importing and Converting Map Data on page 4-1 for instructions on how to convert map data to suitable format.

Commercial Map Data Formats - Source Database

All map data formats in this table are imported as "source database".

Format name	Data representation R = raster, V = vector, T = text	Map type	Associated with coordinate system	File extension	Viewable in * 32 bits	Viewable in * 64 bits	Exportable to *	Description
Vertical Mapper	R	landuse elevation traffic	Y	.grc .grd	Y	N	N	MapInfo plug-in. Used for example in Mentum Planet/Planet EV. Also called NWGrid.
Planet DMS	R V T		N	(any)	Y	N	N	Binary raster with *projection, index* and *menu files*. Previously used in EET (Ericsson Engineering Tool).
Aircom Enterprise/Asset	R V T		N	.txt	Y	N	N	Binary raster with *projection, index* and *menu files*, all with suffix *.txt*. Imported in the same way as Planet DMS.

*) The "Viewable in" and "Exportable to" limitations refer to what is possible in the map display of TEMS CellPlanner Clients. You can though always view the map data with the map tools started from **File↗Map data**.

Commercial Map Data Formats - Source Files

All map data formats in this table are imported as "source files".

Format name	Data representation R = raster, V = vector, T = text	Map type	Associated with coordinate system	File extension	Viewable in * 32 bits	Viewable in * 64 bits	Exportable to *	Description
ASCII grid	R	landuse	N	.grd, .txt, .asc	Y	Y	Y	Interchange format for ArcInfo (ARC/INFO) rasters in ASCII format. Same as Ungenerated grid (ESRI). Exportable as Grid(GRD).
	R	elevation						
BMP	R	image	N	.bmp	Y	Y	Y	Imported with index file index.txt or ESRI world file (.tfw, .bmw or .gfw). Exported with world file and TAB file.
GIF				.gif	Y	Y	N	
JPEG				.jpeg	Y	Y	Y	
PNG				.png	Y	Y	Y	
TIFF				.tif, .tiff	Y	Y	Y	
SRTM/BIL	R	elevation	Y	.bil	Y	Y	N	Freeware USGS raster format for unprojected WGS coordinate system. See SRTM Elevation Data.
SRTM/HGT				.hgt				
XYZ-raster(ASC)	R		N	.ASC	N	N	Y	* elevation, landuse, buildings
Google Earth	R	image	Y	.kml or .kmz	N	N	Y	Correct format name is KML. Google Earth Placemarks/Areas can be imported with tool **Import generic map file** and exported with tool **Export sites to Google Earth**.
Google Earth 3D	V	3D vector	Y		N	N	Y	
MapInfo MIF/ MID	V	vector	Y	.mif (.mid)	Y	N	Y	MapInfo exchange format. May represent text info. Select .mif, .mid expected in same folder.
MapInfo TAB	V	vector	Y	.tab	Y	N	Y	MapInfo internal format. May represent text info. Exportable in 32 bits only.
	R	image			Y	Y	Y	
DXF	V	vector	N	.dxf	Y	Y	N	Drawing exchange format for AutoCAD. May represent text info.
Shape + DBF	V		N **	.shp	Y	Y	N	ESRI format for vector data
E00	V		N **	.e00	Y	Y	N	ESRI interchange format. All spatial and descriptive vector and raster map data can be combined in one ASCII file.

*) The "Viewable in" and "Exportable to" limitations refer to what is possible in the map display of TEMS CellPlanner Clients. You can though always view the map data with the map tools started from **File↗Map data**.

**) These source files carry coordinate system information, but the current version of TEMS CellPlanner does not use it at import.

Proprietary Map Data Formats - Source Database

All map data formats in this table are imported as "source database", and are associated with a coordinate system.

Format name	Data representation R = raster, V = vector	File extension	Viewable in *		Input to predictions		Exportable to *	Description
			32 bits	64 bits	32 bits	64 bits		
MRR	R	.mrr	Y	Y	Y	Y	N	Multi-resolution raster format
MRV	V	.mrv	Y	Y	N	N	N	Vector format with multiple levels of detail, for vectors and text attributes. New from TEMS CellPlanner 8.0. Mandatory vector and text format for 64 bits JVM, optional for 32 bits JVM.
GeoBox	RV	.grk	Y	N	Y	N	N	Not a map format, but a native file format for raster or vector data. The .grk file describes the other files in the database. Can be imported using an API acquired from TEMS Support.

*) The "Viewable in" and "Exportable to" limitations refer to what is possible in the map display of TEMS CellPlanner Clients. You can though always view the map data with the map tools started from **File↗Map data**.

Other Map Data Formats

To use any other map format as source data a dedicated plug-in is needed.

Contact TEMS support about the possibilities of ordering such a plug-in.

Map Data Format Descriptions

ASCII Grid File Format

Import Format

ARC ASCIIGRID refers to a specific interchange format developed for ARC/INFO rasters in ASCII format. The format consists of a header that specifies the geographic domain and resolution, followed by the actual grid cell values. Usually the file extension is *.asc, but recent versions of ESRI software also recognize the extension *.grd. The file looks like this:

NCOLS	724
NROWS	579
XLLCORNER	417100.000000
YLLCORNER	3396760.000000
CELLSIZE	20.000000
NODATA_VALUE	255
9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 9 etc....	

Records 1 - 6 Geographic header

Coordinates may be in decimal or integer format.

NCOLS	Number of columns in the grid
NROWS	Number of rows in the grid
XLLCORNER	Coordinates of the western edge of the grid
YLLCORNER	Coordinates of the southern edge of the grid
CELLSIZE	Resolution of the grid
NODATA_VALUE	Value that represents missing data

Record 7 -> end of file Data values

These are the values of individual cells typically representing elevation or landuse of a particular area.

Grid values are stored as integers.

XLLCORNER and YLLCORNER are the grid edges, not the edge cell centers. The origin of the grid is the upper left and terminus at the lower right corner.

Planet DMS (EET/Planet) and Asset Projection File Format

The projection file of Planet DMS (EET/Planet) and Aircom Asset is a text file with information about the projection and ellipsoid of the map data.

File Format

Line 1: Name of the ellipsoid

Line 2: UTM zone number (1-60). The most common projection is UTM, Universal Transverse Mercator. If the map data has another projection than UTM this line is blank.

Line 3: Name of the projection

Line 4: Parameters of the projection. When using UTM this line is left blank when map data is located on the northern hemisphere. Map data on the southern hemisphere require parameters.

Projection Parameters

1. Latitude of the projection. In UTM projection this is equally to the equator, 0 degrees.
2. Longitude of the projection, also called the central meridian.
3. False easting, number of meters west of the central meridian the coordinate system starts counting from.
4. False northing, number of meters south of the latitude of the projection the coordinate system starts counting from.
5. 1st parallel (When using Lambert conic conformal projection)
6. 2nd parallel (When using Lambert conic conformal projection)

Examples of Projection Files

Typical projections file with UTM projection, from northern hemisphere:

```
WGS-84
33
UTM
```

Typical projections file with UTM projection, from southern hemisphere:

```
WGS-84
33
UTM
0 15 500000 10000000
```

Note: *Planet DMS does not have information about the geodetical datum in the projection file. Check this with the supplier of map data.*

Planet DMS (EET/Planet) and Asset Folder Naming Rules

The folders of Planet DMS (former EET/Planet) and Aircom Asset formats must be named **exactly** as below to be readable by the preprocessing, import and map layer procedures:

- heights
- clutter
- vector
- text
- buildings
- backdrop

The **vector** folder contains files defining vectors like road network, water features, building polygons and building outlines.

The **buildings** folder contains files defining raster layer with building heights calculated from ground level.

Multiple Resolution Calculations

Alignment of Multiple Resolutions

When converting map data to MRR using preprocessing, the multiple resolutions are aligned according to the criteria specified in this section.

If the source databases are unaligned or do not use the same coordinate reference system, the map data with the coarser resolution is aligned with the map data with the finest resolution.

The coarsest resolution in the MRR database is calculated as a multiple of the finest resolution. The resulting resolutions between finest and coarsest resolution are calculated as 50%, 12.5%, 6.25% and so on of the coarsest resolution down to the finest resolution.

The following examples describe the alignment of MRR databases:

Case	Resolution of source databases	Resulting resolution in target MRR database
1	The source map databases have resolutions of 10 and 50 meters respectively.	The resolutions in the MRR database are 10 and 50 meters.
2	The source map databases have resolutions of 10, 15, and 50 meters.	The finest resolution in the MRR database is 10 meters and the coarsest resolution is 50 meters (5 meters x 10 = 50 meters). The possible resolutions in-between are: 25 meters and 12.5 meters. All map data in the MRR database must be stored in one of these resolutions. In this case, the 15 meter data is re-sampled to 12.5 meter. The resolutions in the MRR database are 10, 12.5 and 50 meters
3	The original map databases have resolutions of 15 and 50 meters.	The finest resolution in the MRR database is 15 meters and the coarsest resolution 45 meters (15 meters x 3 = 45 meters). The 50 meter map data is re-sampled to 45 meters resolution.

Modified Landuse Codes

When one landuse database is preprocessed to an MRR database, the landuse codes are the same in the MRR database as in the source database.

When multiple landuse databases are preprocessed to an MRR database, the target MRR database contains all landuse codes from all source databases, but the code numbers may differ between the source databases and the target MRR database.

Note: *You must consider the change of landuse codes when migrating projects from older versions of TEMS CellPlanner. The differences affect propagation models, traffic density maps and pathloss fading tables.*

The landuse codes from the database with finest resolution are added first to the list of landuse codes in the target MRR database, and they are exactly the same as is the source database. If the landuse codes in the other source databases are not the same as in the source database with finest resolution, they are appended to the list of landuse codes in the target MRR database. This means that they will not have the same code number in the target MRR database as in the source database.

The landuse codes for the MRR database are found in the <MRR_database_name>.ini file stored together with the MRR database.

Example of Landuse Codes

Source database A, with resolution 5m, has the following landuse codes:

Code	Landuse
1	Water
2	Park
3	Buildings

Source database B, with resolution 20 m, has the following landuse codes:

Code	Landuse
1	Open
2	Water
3	Forest

After preprocessing, the landuse codes in the target MRR database are as follows:

Code	Landuse
1	Water
2	Park
3	Buildings
4	Open
5	Forest

In this case the code number of *Open* and *Forest* are not the same in the target MRR database as in the source database.

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